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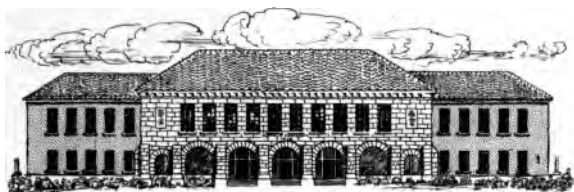


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PART I.

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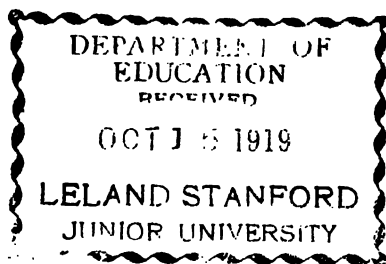
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A GRADUATED COURSE
OF SIMPLE
MANUAL TRAINING EXERCISES



A GRADUATED COURSE
OF SIMPLE
MANUAL TRAINING EXERCISES
FOR EDUCATING
THE HAND AND EYE

BY
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PART I.
CONTAINING THE FIRST AND SECOND SERIES

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PREFACE.

It is now very generally admitted that the Kindergarten exercises, as carried out in many of the best infant schools, provide an excellent means of education through the medium of the operations performed by the children themselves with the objects comprising the various gifts. And it has been a frequent source of regret that arrangements were not made for continuing such work, in a more advanced form, with the children after they had left the infant school. The great attention which has recently been given to the general subject of technical education has considerably strengthened this feeling, and has led to attempts being made to supply this deficiency in the ordinary school course.

The present scheme of exercises, drawn up at the request of the Liverpool School Board, and successfully introduced into nearly all their schools, is intended to provide a graduated four years' course of practical work for children of from seven to eleven years of age (Standards I.—IV.). It consists of four series of exercises, each series containing thirty exercises, and forming the subject of a year's work. The present volume contains the first and second series; the second part, containing the other two series, is in an advanced stage of preparation.

The author is indebted to several teachers in the Board's Schools, and to the Board's inspectors, for various criticisms suggested in the course of the actual working out of the exercises in the schools.

The exercises involve the use of several different materials—wooden laths, paper, wire, clay, etc.—and this is done partly

for the sake of variety, but more especially in order that the children may become practically acquainted with the different characters of various substances and the different methods of manipulating them. Whilst there is much to be said in favour of confining the exercises to one particular branch of work, and so bringing it to a considerable degree of development and making the children expert in its performance, it is probably wiser in the earlier stages of education to aim at a general all-round development of the powers and faculties, and to specialise afterwards when special tastes and powers begin to show themselves. Should, however, the special opportunities or tastes of any teacher incline him or her to one particular material or kind of exercise rather than another, it would be very easy (with the help of such excellent manuals as Ricks' "Hand and Eye Training") to introduce a number of such supplementary exercises. It is, however, strongly recommended that the full course of exercises here given should be taken, and in the same order.

The great object attempted being to educate the mind through the medium of the hand and eye, the production of objects and designs of beautiful form and colour, while not altogether omitted, is subordinated to the intelligent and accurate performance of each step in the exercise. There is consequently very little show work produced, though quite sufficient in the way of construction of simple objects and designs to maintain the interest of the children.

Experience has shown that the children look forward with delight to these lessons; and I have the authority of teachers in several different classes of schools for the statement, that the exercises, when properly carried out, have the effect of brightening and quickening the intelligence of the children, as well as of developing their powers of observation, and training their fingers.

The exercises have been largely based upon the ordinary drawing exercises, and may in fact be regarded as, for the most part, applied drawing. It will therefore be found that the manual training lessons and the drawing lessons materially assist *each other.*

Preface.

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The various materials used are such as may readily be obtained ; but Messrs. Philip, Son, and Nephew, 51, South Castle Street, Liverpool, have specially prepared most of the materials and apparatus to meet the wishes of the author.

W. HEWITT.

LIVERPOOL, 1892.

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INTRODUCTION.

TO THE TEACHER.

THE object aimed at in this course is primarily to develop and train certain faculties and powers of the children by means of a carefully selected and graduated series of practical exercises. The activities of the children are enlisted in the service of their intellectual development ; they are set to do something in order that they may (often perhaps unconsciously) learn something.

Although in many cases the completion of the exercise results in the production of some finished object or design, such production is not to be regarded as the chief end and aim of the exercise, and therefore to be accomplished as speedily and as directly as possible. The work will have its full educational value only when the teacher clearly appreciates the principle that each step in the process should involve the action of the mind as well as of the hand ; and that the result hoped for is as much a quickening of the intellectual powers as an increased accuracy of the eye or dexterity of the fingers.

The exercises are intended to cultivate habits of careful attention and correct observation, to train sight and judgment in the estimation of symmetry and accuracy, and to practise the hand in the manipulation of various materials, so as to give concrete expression to ideas of form or position previously existing in the mind. Orderly and cleanly habits of work should be encouraged, and the children should be led to recognize and appreciate what is exact, symmetrical, and harmonious.

Many of the exercises may be regarded as practical applications of the ordinary drawing exercises,—parallels, various angles, triangles, and other geometrical figures, forming the greater part of the constructions to be made. Opportunities will frequently arise where the drawing and manual training may be made to bear directly on each other, the object constructed in the one forming the copy to be reproduced in the other, and *vice versa*. Each subject will thus be a means of imparting increased interest to the work of the other, and promoting its progress.

By frequent use in the practical exercises, the geometrical terms will gradually come to have very definite and real meanings for the children; in some cases more correct than the ideas usually obtained from the ordinary definitions and diagrams. For example, the term “square,” applied to a piece of paper or metal, will become associated in the minds of the children with the idea of surface or area, and not merely be confined to the lines bounding such a surface; while in the same way a block of clay modelled into the form of a cube will give them such an idea of volume or solidity as no verbal definition or perspective drawing could do.

It is, therefore, well to take advantage of every opportunity in the early lessons (and to recur to it frequently in the later exercises) of drawing attention to the more common terms used in describing certain forms and positions, and to note any special properties connected with them,—*e.g.* that all the sides of a square are equal straight lines, the angles or corners equal, the lines from the centre of a circle to the circumference all equal, etc. On the other hand, it is advisable not to introduce more technical terms than are really necessary for the purpose of description, nor to require the children to learn off by heart set definitions of those terms. It cannot be too strongly insisted upon that in lessons such as these we are dealing primarily with *things*; that *words* are used only for convenience in communicating our ideas to each other; and that therefore an accurate personal knowledge of the thing is the first essential, while the term by which it is spoken of must *come after and not before* such knowledge is acquired.

For the same reason as it is undesirable to load the memories of the children with unnecessary technical terms, so in many of the exercises it is not advisable to confuse their minds by pointing out everything that the exercise might be made to illustrate, as it appears to the much wider knowledge of the teacher. Much of this knowledge, if enlarged upon, would be beyond the present powers of comprehension of the children. It may be expected, however, that such facts and relationships, though not obviously pointed out, will in many cases so impress themselves (unconsciously) upon the minds of some at least of the children, as to bear fruit in due season.

It is hoped that the children will gradually be led by the constant use of the rule for measurement, and the frequent exercises required of estimating distances by the eye, to form approximately correct ideas of the sizes of bodies; and that the expressions, inch, half-inch, three inches, etc., will come to correspond with more or less exact ideas of those dimensions which they have obtained by personal experience.

It is a good plan to spend a little time at the commencement of an exercise in conversation with the children, showing them, when possible, a previously prepared copy of the object or design to be constructed, or a sketch of it on the blackboard; and discussing the number, character, and position of the parts of which it consists, their equality, parallelism, etc.,—and also in a brief examination of the materials and apparatus to be employed. The children will thus have in their minds an idea of the object to be accomplished, and a feeling that their work is being carried out in accordance with a previously arranged and intelligible plan, into which they can more or less enter.

The following exercises are set out in such a manner as to show the various steps which each comprises. After each step the teacher should examine the work to see that it has been satisfactorily done before the next step is attempted. And it is very desirable that where a mistake has been made the child should be led to find out the error for himself, by comparison with the copy or of one portion of his work with another, rather than that the teacher should immediately pro-

ceed to point it out. Each step should be illustrated by the teacher performing similar work (on a larger scale, if necessary) in front of the class, or by a sketch on the blackboard.

Each exercise will occupy from thirty to forty minutes, or occasionally perhaps somewhat longer. In case the exercise is not completed by the end of the time set apart for the lesson, it is well to let each child put away his unfinished work, materials, and apparatus in a large brown-paper envelope, having his name written outside; these may then be readily distributed when the lesson is resumed. It will probably be necessary to go over some of the earlier exercises two or, in some cases, three times, before the greater number of the children can do them satisfactorily. The time and trouble so spent will, however, be amply repaid by impressing the children with a sense of the thoroughness and accuracy required even in the most simple operations, and thus leading them to exercise greater care in all their future work. And a very much better educational result would be obtained by accomplishing only a portion of a series in a given time in a thoroughly satisfactory manner, than by getting through the whole series and accepting less perfect work.

Hasty and careless work should in all cases be discouraged; an essential feature of the course being that the exercises, although simple, are to be carried out in as accurate and precise a manner as can reasonably be expected of the children, considering the limited extent of their powers and of the means at their command. The teacher should set up a high standard, and regulate the praise bestowed on the work according to its approximation to this standard. And while selecting any good and completed exercise for special praise (and perhaps, where possible, for preservation with the child's name attached), the children should be given to understand that such work is only what might be accomplished by, and is indeed expected from, every child in the class.

If time permitted, some of the exercises might be repeated by the children from memory, a completed copy of the object being first shown to them. This memory of form is a faculty *that it would be well to cultivate.*

The number of exercises in each series is somewhat limited, and it may be found, in many cases, that a certain number of others could very well be got through in the course of a year's work. These might consist of a development of any of the varieties—clay modelling, paper folding and cutting, wirework, etc.—in which teachers or children are specially interested, or for which special facilities present themselves. Among these supplementary exercises it would be well to introduce several in which the children were left to make their own designs, or to vary the design in one of the set exercises. And in the same way there will be opportunities for the quicker children, on completing the ordinary exercise, to utilize the remaining time of the lesson in constructing something according to a pattern of their own invention. In a few instances such an opportunity is pointed out in the notes, but others will frequently occur. This element of independent design will be brought out more in the later series.

In connection with the list of materials and apparatus which precedes each series of exercises, the teacher will find some notes on the characters and manner of use of the various articles, which have been suggested by practical experience, and which it would be well to keep in mind. Attention is called to these notes in the first exercise only in which the articles are used.

It is hardly necessary to point out how essential it is that the teacher should himself or herself practise well the steps of each exercise before attempting to take the class through it; for in no other way will it be possible to understand the various little difficulties which are likely to arise and the best method of performing the work.

FIRST SERIES.



LIST OF APPARATUS AND MATERIALS.

[The references are to the notes which immediately follow the list.]

Narrow wooden laths, about $5'' \times \frac{1}{4}''$. (*Note A.*)

Beads. (*Note B.*)

Small scissors, with rounded ends. (*Note C.*)

Flat wooden rules, 1 foot long, divided into half-inches.

Circular disc, 3" diameter, preferably of metal.

Square, 3" side, preferably of metal.

Large plain white paper squares, 6" side.

Small plain white paper squares, 4" side.

Coloured (various) paper squares, 4" side.

Ditto, gummed at the back. (*Note D.*)

Paper strips, white, 12" long, half-inch wide.

Squared paper for drawing (quarter-inch squares), pieces 5" square.

Short lengths (about 4") of various-coloured wools in small bag. (*Note E.*)

Teacher's corresponding series of wools in small skeins.

Soft copper or brass wire (about No. 26) in small coils of about 7 feet. (*Note F.*)

Pieces of planed wood, about 3" square, $\frac{1}{4}''$ thick.

Rings, brass or black, about $1\frac{1}{4}''$ diameter.

Modelling clay. (*Note G.*)

Earthenware jar with lid, for keeping moist clay.

Small modelling boards, about $11'' \times 7''$.

Simple wooden modelling tool. (*Note H.*)

Small sponges.

String, thin for cutting clay, and some thicker for Exercise IX.

Lead pencils.

NOTES ON THE APPARATUS AND MATERIALS AND THEIR USE.

(A) The *laths* should be of wood which breaks easily and sharply across, not leaving very irregular edges. Narrow strips of paper might be sometimes used instead of the laths, but they are not so convenient.

(B) The *beads* should be of fairly large size, so that they may readily be handled and moved. They should also have a flat side, so as to stand steadily on the table or desk.

If the slope of the desks is so great that much difficulty is found in getting the children to place the beads so that they do not roll off, the exercise might be performed on a modelling board or slate laid on the desk and made as nearly level as possible by placing a book under one edge; or *small* flat buttons or flattened shot might be used on the desks instead of the beads; or the laths or rings might be laid on a slate placed on the desk in the usual way, and the children told to mark points with their slate pencils instead of laying beads.

(C) Small *scissors* with rounded ends can be had for about one penny the pair, and have the advantage that young children cannot hurt themselves with them. They have the disadvantage usually of working somewhat stiffly at first, and care must be exercised when cutting paper with them not to take the cut quite to the end of the scissors, as the ends tear the paper.

(D) The *coloured paper squares* should have a smooth glazed surface, so as to prevent them from being readily marked by the fingers. Those which are coated with gum at the

back are somewhat brittle, and, when folding and creasing them, it should be done with the coloured surface inside.

In mounting the gummed squares on other paper, the children should be made to lay them in position before moistening the gum; and it is then sometimes advisable to mark one or two points at the edges or corners as guides in laying them down again when wet. They may, however, be stuck down by holding them in position, when correctly laid, and raising one corner or edge at a time, moistening it with the sponge and fastening it down before raising another part. Or the paper may be removed, and the whole gummed face wetted by dabbing (*not rubbing*) it with the wet sponge.

The children might be allowed to use pieces of paper (old exercise paper, etc.) to lay over the coloured sheets while rubbing them to fasten them down.

The packets of gummed paper should be kept in a dry place, or they are liable to stick to each other.

- (E) The pieces of *wool* should be thick ("fleecy" or "double Berlin"), and about 4 inches long. They should comprise black, white, and two or three shades of red, yellow, green, and blue—in all about twenty specimens. (A special series of wools suitable for these exercises, and used also to illustrate the lessons on colour in the author's "Elementary Science Lessons," has been prepared by Messrs. Philip, Son, and Nephew, South Castle Street, Liverpool. The same firm has also arranged to supply all the other apparatus required for these exercises.) Each child should have a set of wools, which may very conveniently be kept in small calico bags.

A set of small skeins of corresponding colours should be provided for the teacher to use for class illustration.

The children, when sorting the wools, should be provided with a piece of clean white paper on which to lay the pieces, so as better to show the colours.

- (F) The *wire* must be thin and soft, so that the children may readily work it with their fingers. It may be cut into

lengths with the scissors. Care should be taken to prevent the wire getting into bends or kinks, as it would then be difficult for the children to straighten it out again properly. If it should get somewhat bent, it may be straightened by drawing it over a rounded slate-frame.

- (G) The *modelling clay* recommended is that used by artists, and is best bought in a state of fine dry powder. If obtained in dry lumps, it will be well to reduce them to powder, with a large pestle and mortar if possible. The clay is of a light grey colour, and should be free from gritty particles.

The powder is prepared for use by mixing it with water, just as in making dough, mixing the powder and water well together with the hands, or with a large spoon or stirrer. When properly prepared it will be soft, but not sticky; if it sticks at all to the fingers it is too wet, and some more dry powder should be worked into it. If the bowl or board on which the clay is being prepared is dusted with some of the dry powder the clay will not so readily stick to the article.

When the clay has been once properly made up, it may be kept in good condition for some time by enclosing it in an earthenware jar covered with a lid of the same material. If it is found that the clay is getting somewhat too dry, a damp duster laid in the jar along with the clay will probably soon make it all right.

The pieces of clay, when being worked in the hands, tend to become dry, especially if too small pieces are used. (As a rule, each child should be given for these exercises a piece of clay sufficient to make a ball from 1½ to 2 inches in diameter, or about as much as would be made from a quarter of a pound of powder.) If it is found that the clay in the process of modelling is getting too dry, the children might be provided with a damp sponge with which to slightly moisten their hands occasionally—not, however, making them so wet that the clay will stick to them. (*It is hardly necessary to say that the sponges*

should be well rinsed before being used again for paper mounting.)

The modelling should be done on special boards or old slates (without frames), and it is found that, if reasonable care be taken, neither the desks nor the children's clothes need be soiled by the work.

The moist clay may readily be cut with a knife or with a piece of thin string. When the children have to cut the clay in the course of an exercise, they should be supplied with a piece of thin string about six inches long.

- (H) The *modelling tool* is not much required in the simple exercises of the first and second series, almost all the work being done with the finger and thumb. When a cube or other figure with flat sides is to be made, the clay should be pressed or slightly struck against the modelling board; or the small square wooden blocks provided for the purpose may be used, especially where pairs of flat sides parallel to each other are to be produced.

Perhaps the most useful general tool is the one shaped as in the figure.



Exercise I.**PAPER FOLDING, TEARING, AND LAYING.**

MATERIALS.—*Large white paper square.*

Fold paper down middle, and crease well.

Tear paper along crease. (The creased paper should be held in both hands, with the ridge of the crease towards you, and the tearing gradually started. Then the paper may be laid flat on the desk and one part held down with the hand while the other is torn off.)

Repeat folding and tearing to get eight equal long strips.

Lay strips on desk parallel to each other and at approximately equal distances (Fig. 1).

Take up half the strips, and lay parallel to and equidistant from each other, but perpendicular to the other strips (Fig. 2).

Lay one set over another to form a grating (Fig. 3).

NOTE.—If, as is probable, it is found necessary to repeat this exercise two or three times before the children learn to tear the paper neatly, the manner of laying the strips after tearing may be varied thus :

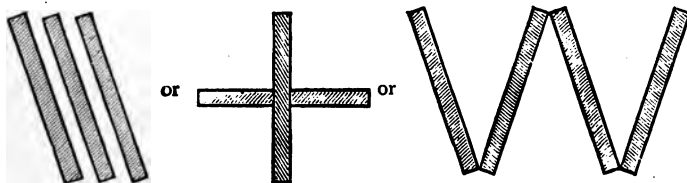


FIG. 1.

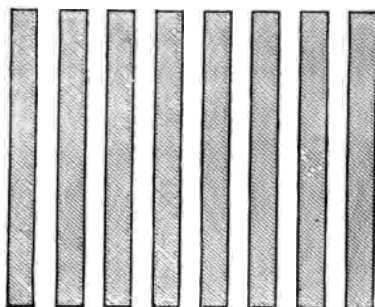


FIG. 2.

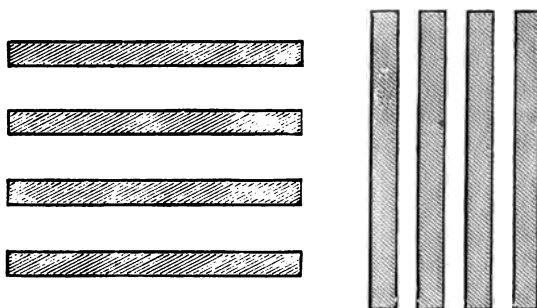
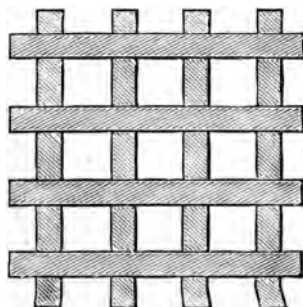


FIG. 3.



Exercise II.**LATH AND BEAD LAYING—ANGLES.**

MATERIALS.—*Six wooden laths, three beads.* (See Notes A, B, p. 4.)

Lay laths parallel to each other and equidistant (Exercise I., Fig. 1).

Lay three laths end to end in a straight line.

Lay other three laths in straight line parallel to last (Fig. 1).

Lay two laths inclined to each other to form an angle, and lay a bead *in* the angle.

Lay two laths to form a right angle.

Lay another pair to form an angle less than a right angle (acute angle); and a third pair to form an angle greater than a right angle (obtuse angle).

Lay a bead in middle of angle, *i.e.* on line bisecting angle (Fig. 2).

Lay laths to form letters T, H, W, M, A, etc. (Note various angles in letters; and such facts as that upright of T is opposite middle point of cross-piece, that outer sides of M are parallel to each other, but not those of W, etc.)

FIG. 1.



FIG. 2.

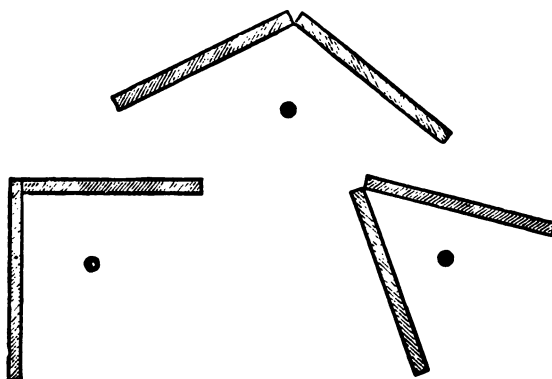
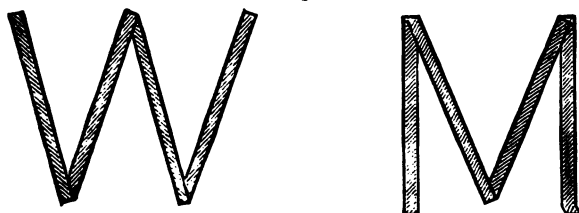


FIG. 3.



Exercise III.**PAPER FOLDING AND TEARING—SQUARE AND TRIANGLE.**

MATERIALS.—*Small paper square (white or coloured).*

Examine paper square, and note four equal sides and four right angles.

Fold square accurately along one diagonal (Fig. 1). (Note which sides are now equal, and which angles are not right angles.)

Fold again, laying one small angle on the other (Figs. 2, 3). (Again compare sides and angles.)

Crease well, then open out the square, and note the crease lines dividing the square into four equal triangles.

Tear carefully along creases.

Lay the triangles on each other to show equality.

Lay the triangles with their four long sides in a straight line (Fig. 4).

Lay the triangles in similar positions, with four short sides in straight line (Fig. 5).

FIG. 1.

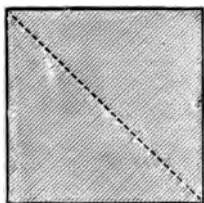


FIG. 2.

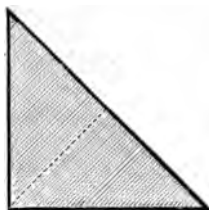


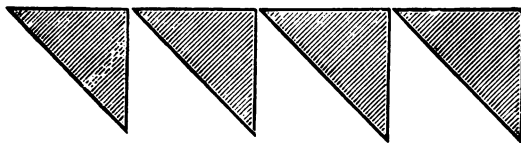
FIG. 3.



FIG. 4.



FIG. 5.



Exercise IV.

PAPER FOLDING, CUTTING, AND LAYING

MATERIALS.—*Small paper square (white or coloured).*

Fold square as in Exercise III.

Crease well, open out, and slightly press out crease lines.

Cut along crease lines with scissors. (*See Note C, p. 4.*)

Compare triangles with each other, and note that one side of each is longer than the other sides.

Lay triangles together to form original square. (Note that the long sides of the triangles form the sides of the square.)

Slightly separate the triangles to form symmetrical pattern (Fig. 1).

NOTE.—The latter figure might—in another lesson, if necessary—be drawn on a slate, either freehand or with ruler. Also the children might be allowed to lay another pattern of their own design, *e.g.* Figs. 2, 3, 4.

FIG. 1.

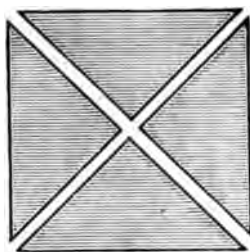


FIG. 2.

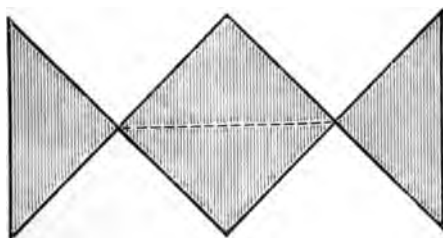


FIG. 3.

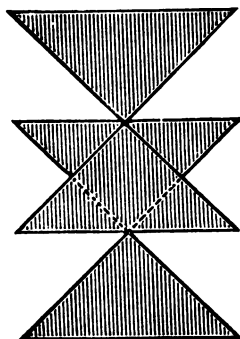
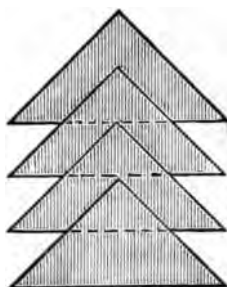


FIG. 4.



Exercise V.**LATH LAYING—TRIANGLES.**

MATERIALS.—*Eight wooden laths.*

Compare the laths together (set them together with one end resting on desk) to show that all are of equal length. (Make them equal by breaking, if necessary.)

Lay four laths together to form a square.

Lay another lath along diagonal of square (Fig. 1). (Note that the diagonal is longer than a side.)

Remove two laths to leave an incomplete triangle (Fig. 2).

With three other laths form complete triangle (Fig. 3), and compare this with incomplete triangle. (Note sides of this triangle are equal; one side of other triangle, if completed, would be longer than other sides; note also that there is no right angle in complete triangle.)

Take away the laths forming the incomplete triangle, leaving the other one untouched.

Hold a lath by its estimated middle point; break there and test the two parts to see if equal.

Try to make triangle with one whole lath and the two halves. (Note, therefore, that not *any* three lines will make triangle.)

Make triangle with two whole laths and one half (Fig. 4).

Break small piece (about an inch) off one lath, and with three unequal pieces (*i.e.* a whole lath, half lath, and the lath which has had a small piece broken off) form a triangle (Fig. 5).

Mix all the laths and pieces together, and then select those required to form respectively (1) a triangle with three sides equal; (2) with only two sides equal; (3) with all sides unequal.

FIG. 1.

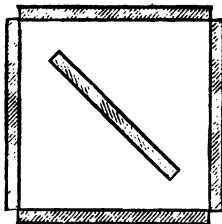


FIG. 2.

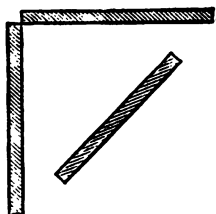


FIG. 3.

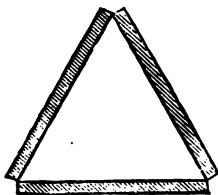


FIG. 4.

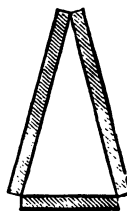


FIG. 5.



Exercise VI.

PAPER FOLDING, CUTTING, AND LAYING—SQUARES.

MATERIALS.—*Small white paper square ; metal square ; lead pencil ; scissors.*

Trace outline of model square on paper. (See that pencil is sharp, and that the point is kept close to the edge of the model in drawing the outline.)

Cut out square along ruled outline, taking care to get corners accurate.

Fold square twice at right angles to form four squares ; crease along folds, and then open out sheet (Fig. 1).

Cut carefully along crease-lines, after first partly flattening them.

Compare the four squares with each other as to size and shape.

Lay the squares at equal distances with bases in straight line (Fig. 2).

Lay the squares at equal distances with diagonals in straight line (Fig. 3).

Arrange squares to form symmetrical pattern, to design of children themselves (Figs. 4, 5, 6).

FIG. 1.

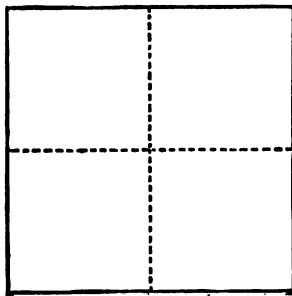


FIG. 2.

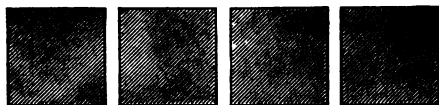


FIG. 3.

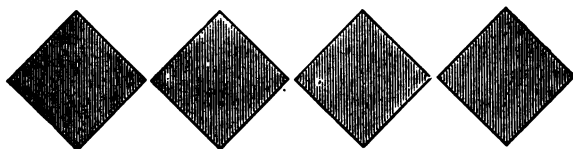


FIG. 4.

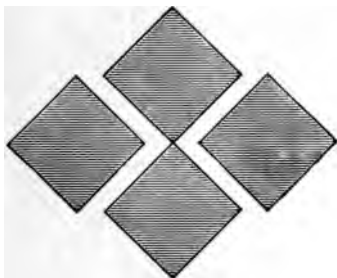


FIG. 5.

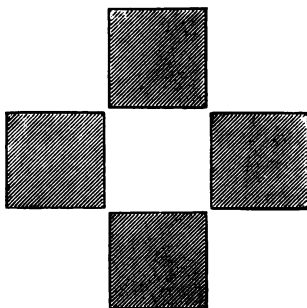
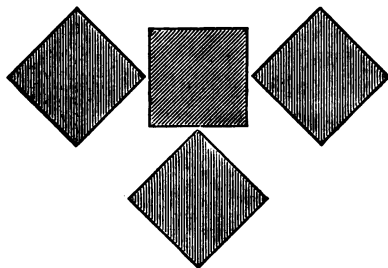


FIG. 6.



Exercise VII.**BEAD LAYING AND PAPER CUTTING.**

MATERIALS.—*Small paper square ; scissors ; ruler ; lead pencil ; five beads.*

Lay bead on estimated middle point of each edge of paper square.

Lay another bead in estimated middle point of square. (Note that central line should be in line with beads on opposite sides.)

Remove beads, fold and crease square along two middle lines at right angles as in last exercise.

Open out square, flatten, and lay on desk (Fig. 1).

Lay bead as directed in middle of "upper left-hand square," etc.

Lay beads at bottom corners of square and at middle point of upper side.

Rule lines joining points last indicated (Fig. 2).

Cut out the central triangle (Fig. 3).

Lay together other two pieces to form triangle similar and equal to first (Fig. 4).

Cut off small triangle marked by crease-line across larger one.

Lay small triangle symmetrically on portion from which cut (Fig. 5). (If children use coloured paper, a child might change the small triangle with his neighbour for one of different colour.)

FIG. 1.

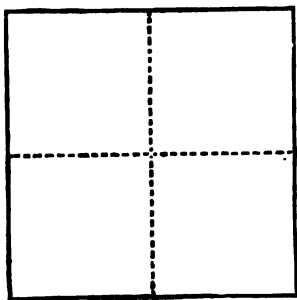


FIG. 2.

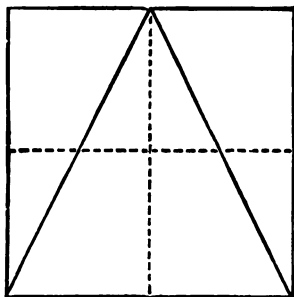


FIG. 3.

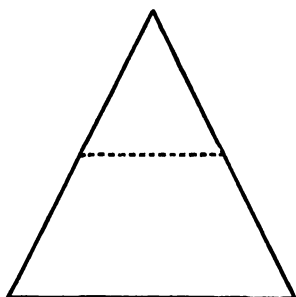


FIG. 4.

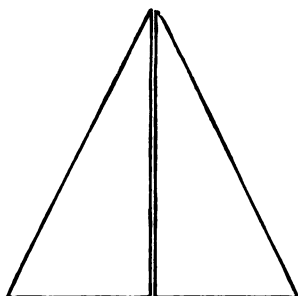
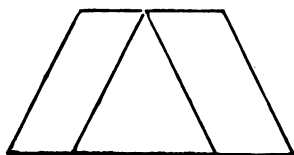


FIG. 5.



Exercise VIII.**MEASUREMENT.**

MATERIALS.—*Paper strip (about 12" \times $\frac{1}{2}$ ") ; foot rule ; lead pencil.*

Measure and mark point on each edge of paper distant one inch from one end.

Rule line joining the marked points and fold paper on line.

Compare this folded inch with length of finger joints, width of rule, etc.

Carefully fold whole strip in inches (folding backwards and forwards alternately) ; open out, and mark in numbers with pencil. (The inch marks are found by folding rather than with the rule, as an exercise in accurate folding.)

Mark in points indicating half-inches by help of rule.

Measure with strip (and also with rule) length of fingers, sides of book or slate, width of desk, circumference of wrist, etc. (Note advantage of using strip that will bend in measuring round wrist, etc.)

Exercise IX.

STRING MEASUREMENT AND DIVISION.

MATERIALS.—*Piece of string over 12" long ; rule ; scissors.*

Cut piece of string to exact length of twelve inches by the rule.

Lay out string on desk and place finger on estimated middle point.

Take up string by estimated middle point, and double it to test if correct.

Crease string at true middle point (found by doubling), measure each half with the rule, and tie knot at centre.

Similarly find middle point of each half, first estimating it, then measuring and tying knot.

Fold string into three equal parts ; cut there, and measure each part. (If the string is rather thick, the knots will take off appreciably from the length of each piece as calculated.)

Unravel one piece of string (if not too thin and tightly twisted) to show its component fibres.

Exercise X.**CLAY MODELLING—BALL, CYLINDER, AND DISC.**

MATERIALS.—*Moist clay (sufficient to make ball $1\frac{1}{2}$ to 2 inches diameter); modelling board; damp sponge. [Large sphere and cylinder, as used for model drawing, in front of class.]*

Roll the clay (*see Note G, p. 6*) on modelling board, or between the hands, to form well-shaped ball or sphere (Fig. 1). (Lay the clay sphere on the board, and show that it rolls readily in any direction.)

Roll out clay on board to form cylinder; flatten the ends and set cylinder to stand vertically (Fig. 2).

Flatten the clay to form an approximately circular disc (Fig. 3). (Compare with coin or metal disc used in exercises.)

[If there is time, when the exercise is well done, let children model clay into form of any object they choose.]

FIG. 1.

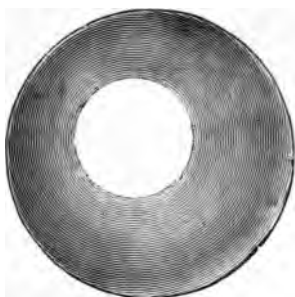


FIG. 2.

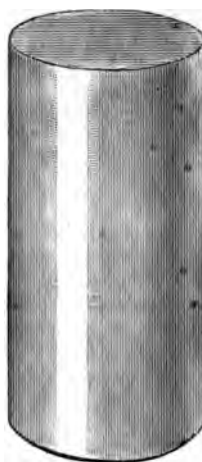
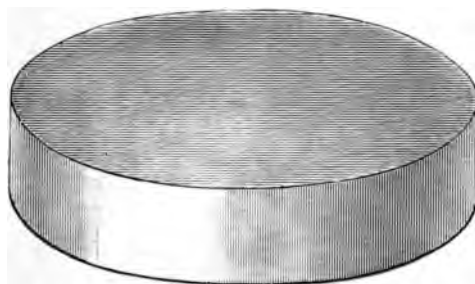


FIG. 3.



Exercise XI.**CLAY MODELLING—BOWL.**

MATERIALS.—*Moist clay ; modelling board ; thin string (about six inches long) for cutting clay ; damp sponge. [As a model use an orange cut in two ; one half having the pulp carefully removed, leaving the peel unbroken.]*

Roll the clay into a sphere (Fig. 1).

Cut sphere with thin string into two hemispheres. (Compare the hemispheres with each other and with original sphere.)

Lay one hemisphere on its flat face, other on its curved part (Figs. 2, 3). (Note how easily latter rocks from side to side, while former stands steadily.)

Model one hemisphere into a hemispherical bowl, similar to peel of half-orange (Fig. 4).

[If there is time, attach simple handle to bowl, first wetting points of contact, and with remainder of clay let children model any object they choose.]

FIG. 1.

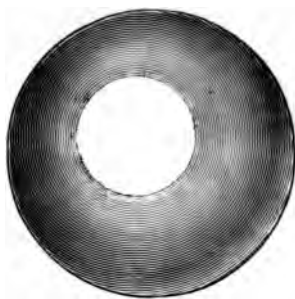


FIG. 2.

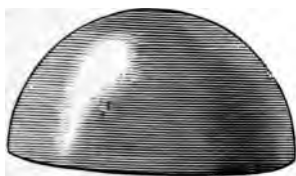


FIG. 3.



FIG. 4.



Exercise XII.**CLAY MODELLING—REPETITION.**

MATERIALS.—*Moist clay ; modelling board ; thin string for cutting clay ; damp sponge.*

Roll clay into sphere.

Cut sphere with string into two hemispheres.

Cut each hemisphere into two equal parts.

Roll each of four pieces into small sphere and lay together to compare sizes.

Retain one piece in form of sphere, make second into cylinder, third into bowl, and fourth into object chosen by child himself. (Note that there is an equal quantity of clay used for each object.)

Exercise XIII.**PAPER CUTTING AND BEAD LAYING—CIRCLE.**

MATERIALS.—*Small white paper square ; scissors ; nine beads ; model circular disc (metal) ; lead pencil ; rule.*

Lay circular disc symmetrically in middle of paper square.

Outline circle on paper. (See that point of pencil is kept close to model.)

Cut carefully along the outlined circle.

Lay paper circle on desk. (Note that it looks the same in all positions on desk, having no corners.)

Lay bead in estimated centre of circle.

Lay four beads on circumference at opposite points, and note if all are at same distance from central bead (Fig. 1).

Lay other four beads on circumference half-way between first four.

Take up beads from circumference, and lay row of five across circle as a diameter (Fig. 2). (Note two semicircles.)

Lay other four to form diameter at right angles to first (Fig. 3). (Note four quarter-circles and four right angles.)

Fold circle along several diameters and crease.

Open out creased circle and measure with the rule the various diameters creased to show all equal (Fig. 4).

FIG. 1.

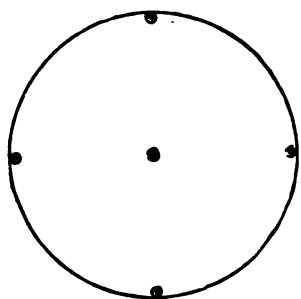


FIG. 2.

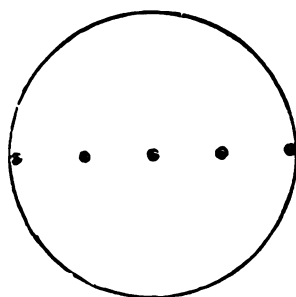


FIG. 3.

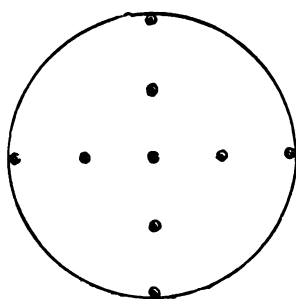
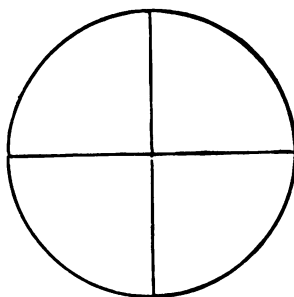


FIG. 4.



Exercise XIV.**LATH AND BEAD LAYING—CIRCLE.**

MATERIALS.—*Four laths ; rule ; lead pencil ; eight beads ; slate and pencil.*

Measure the laths to see if all of equal length, and make equal if necessary.

Find middle point of each lath and mark with pencil.

Lay two laths crossing at middle points at right angles (Fig. 1).

Lay other two laths to bisect angles between first two, and crossing at their middle points (Fig. 2). (Note that from central point portions of equal length project in various directions.)

Lay beads in spaces between ends of laths to outline a circle (Fig. 2).

Break one lath at middle point and use as ruler.

From central point on slate rule lines in various directions, equal in length to half-lath.

Fill up spaces between ends of lines with dots to outline circle (Fig. 3).

FIG. 1.

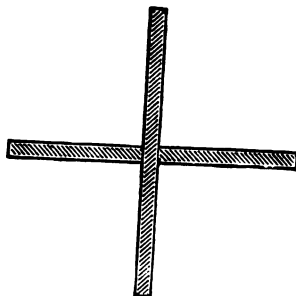


FIG. 2.

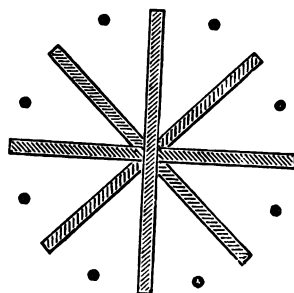
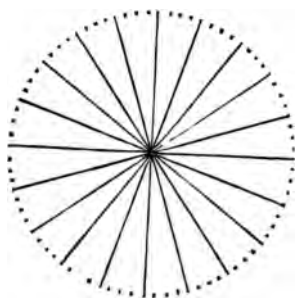


FIG. 3.



Exercise XV.**LATH AND RING LAYING—CARDINAL POINTS.**

MATERIALS.—*Two laths ; five rings ; slate and pencil ; ruler.*

Lay two laths crossing at estimated middle points at right angles (without measurement).

Lay ring symmetrically at point where laths cross (see figure).

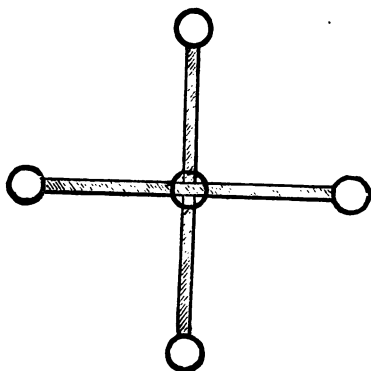
Lay ring symmetrically at ends of each lath.

Draw figure similar, and of same size, on slates, ruling the lines and using a ring to trace the circles.

Print letters N, S, E, W inside circles of drawing.

Draw same figure freehand.

NOTE.—Many other exercises in laying laths, beads, and rings, besides those described in the exercises, will readily suggest themselves ; *e.g.* with laths and beads laying a semicircle, laying a square with beads, etc.



Exercise XVI.

RING LAYING.

MATERIALS.—*Slate and pencil ; rule ; six rings.*

Rule straight line across slate near the top.

Lay six rings touching each other and touching the line.

Mark dot (or small cross) with pencil at estimated centre of each ring (Fig. 1).

Remove rings and note that dots are at equal distances from each other and from line.

Rule second line and place six dots, without measurement, as nearly as possible in similar position to the others (Fig. 2).

Test positions of estimated points by laying rings.

Rule third line on slate, and place six dots in position by measurement, and again lay rings.

Rule line lengthwise on slate and lay rings in pairs on either side of line, touching each other (Fig. 3).

Mark dots in centre of rings, and remove rings.

As before, rule lines and place dots in similar positions, first without, then with, measurement.

FIG. 1.

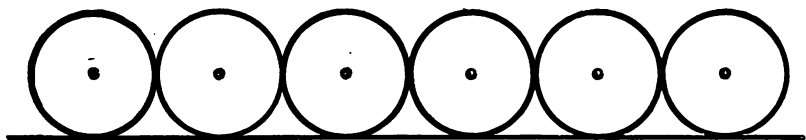
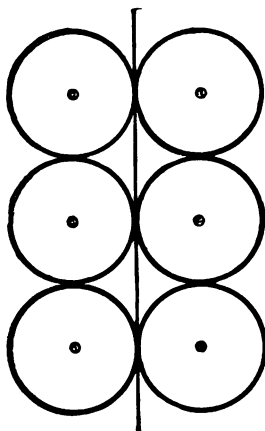


FIG. 2.



FIG. 3.



Exercise XVII.**CLAY MODELLING—SPHERE AND CUBE.**

MATERIALS.—*Moist clay ; modelling board ; two flat (square) pieces of wood ; damp sponge. [Large cube as model.]*

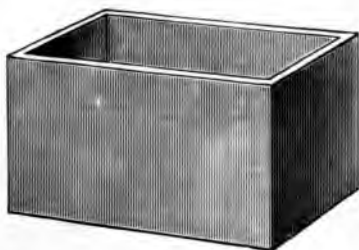
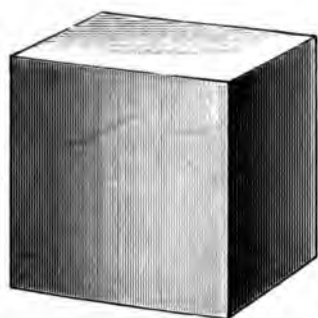
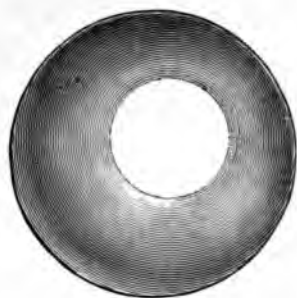
Roll clay into sphere.

Gently press and knock clay sphere on modelling board, to produce flat faces similar to those of cube.

Use flat wooden blocks held parallel (one in each hand) to press clay into form of cube. (Show that there are three pairs of parallel faces on the cube used as a model.)

Make edges and corners of cube as sharp as possible by use of blocks.

Model clay with fingers to form as well as possible a hollow box.



Exercise XVIII.**CLAY MODELLING—DIVISIONS OF SPHERE.**

MATERIALS.—*Moist clay ; modelling board ; thin string for cutting clay ; slate and pencil ; damp sponge. [Large apple or orange of regular shape as a model.]*

Roll clay into sphere.

Cut clay sphere, by thin string, into two hemispheres.

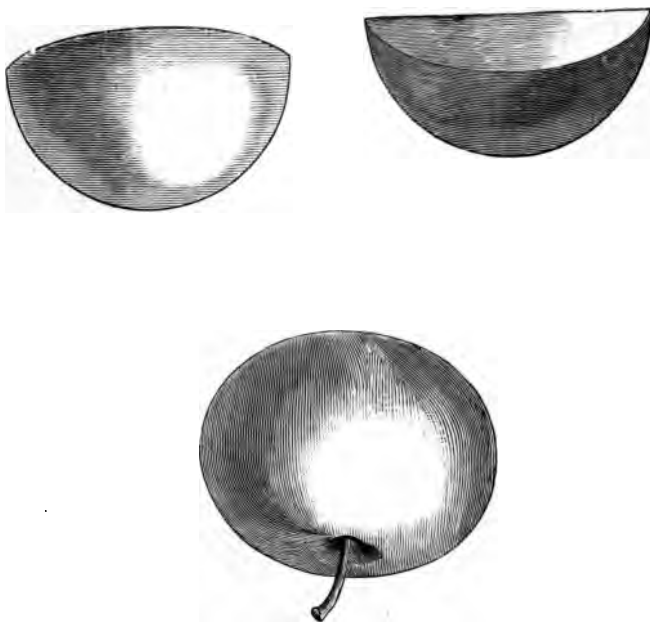
Lay one hemisphere on its flat face on the slate, and trace its circular outline.

Cut other hemisphere into two equal parts with string.

Lay one quarter so produced on one of its flat faces, and trace outline ; then do the same with the other face.

Make up clay again into one piece (moistening the faces of the pieces if necessary).

Make model of apple or orange. (First direct attention to manner in which the fruit differs from a perfect sphere.)



Exercise XIX.

PARALLEL RULING—SIMILAR FIGURES.

MATERIALS.—*Small white paper square ; slate and pencil ; ruler ; scissors.*

Lay square symmetrically in middle of slate.

Rule lines parallel to edges of square, and distant about half an inch.

Rule second series of lines outside and parallel to first, and at similar distance (Fig. 1).

Remove paper square, note that lines drawn form two squares, then replace paper square in former position.

Mark position of corners of paper square carefully with pencil.

Remove paper square and rule lines joining marked points.

(Note that, if all accurately drawn, the diagonals of all three squares are in same straight line.)

Fold square along one diagonal, crease there, and cut.

Lay one triangle so formed symmetrically in centre of slate.

Rule two series of lines parallel to and at equal distances from the central triangle, as was done in the case of the square (Fig. 2).

Remove the paper triangle, examine drawings, and then replace paper in former position.

Mark corners of paper triangle, remove and rule lines joining points.

[If there were time, one of these sets of lines might be drawn freehand.]

FIG. 1.

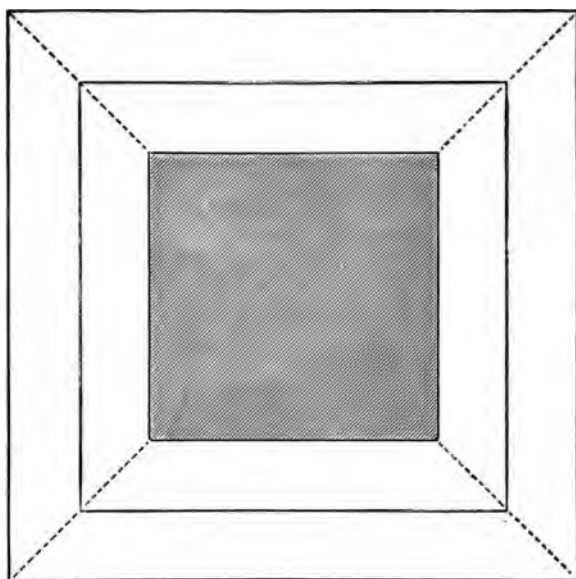
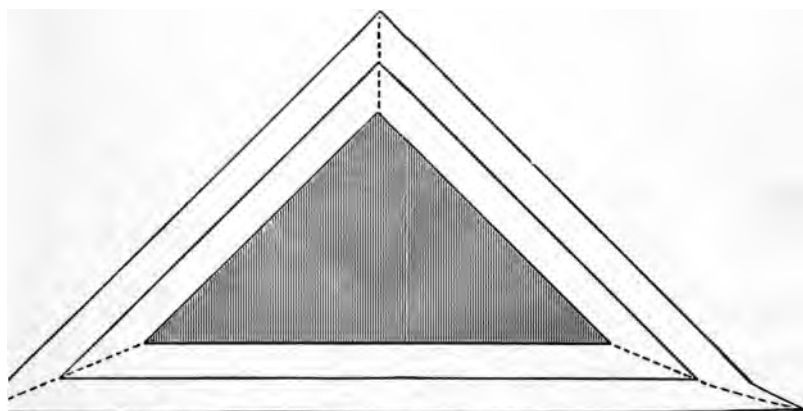


FIG. 2.



Exercise XX.**COLOUR SORTING.**

MATERIALS.—*Series of pieces of coloured wool in bag* (see Note E, p. 5); *large white paper square to lay wools on.* [*Teacher's corresponding set of coloured skeins.*]

Select from bag piece of wool of same colour and shade as specimen skein shown. (Use a very distinct colour at first. Lay the specimen by the side of the piece selected by the child, and ask him to say whether they are exactly alike.)

Repeat with several other colours in succession.

Pick out from the full series of wools all the pieces which could be called red, blue, yellow, etc.

Select from the reds or blues the very light and the very dark ones, and arrange the series in order of shade.

Lay together, or twist loosely together, two pieces selected by teacher which go well together.

Similarly put together two pieces which do not harmonize well. Let child select a piece similar to specimen shown, and then himself find a second colour to go well with first.

NOTE.—This exercise might with advantage be repeated several times at intervals.

Exercise XXI.**PAPER CUTTING AND MOUNTING (PLATE II.).**

MATERIALS.—*Large white paper square; two differently coloured gummed paper squares (to look well together); scissors; lead pencil; rule; damp sponge.*

Lay one coloured square partly over the other on the white square to see whether the colours look well together.

Rule faintly the diagonals of the white paper square.

Lay one coloured square symmetrically in middle of white square. (Note that its corners will be on the diagonals and its sides parallel to those of larger square.)

Moisten the gum and fasten down coloured square in position.
(*See Note D, p. 4*)

Mark points on other coloured square (on gummed side, if the other does not show pencil marks well), at distance of one inch from each corner, and rule lines joining marked points.

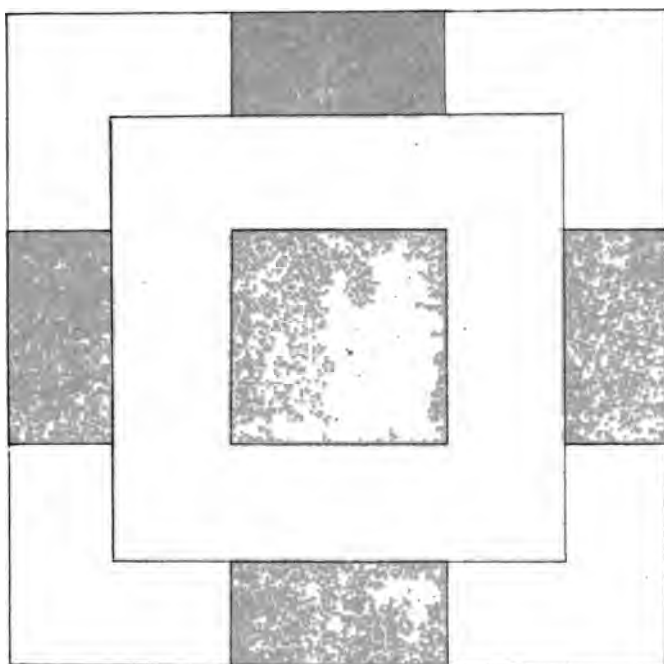
Cut along the ruled lines to leave central square. (The measuring, ruling, and cutting must be very carefully done, as also the mounting, since the finished exercise will test the accuracy of the work.)

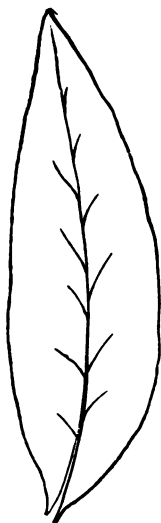
Lay small coloured square just cut in centre of, and with sides parallel to, mounted square. (This may be tested by laying the rule along the diagonals of the three squares, which should all coincide.)

Moisten gum and fasten down small square.

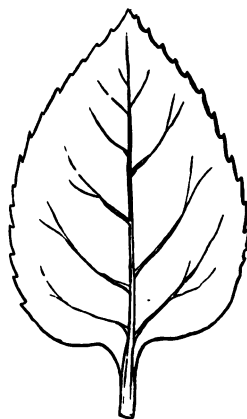
Cut from the coloured strips left from second coloured square pieces having length equal to side of central square, and mount as in Fig. 1, Plate ii.

Plate II.

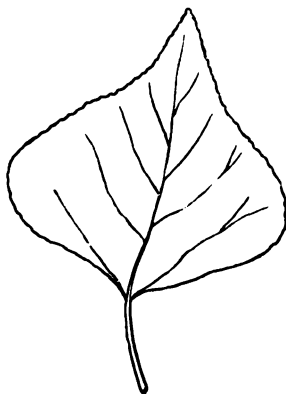




LAUREL.



FUCHSIA.



LILAC.



POPLAR.

(See Exercise XIII)

Exercise XXII.**DRAWING ON SQUARED PAPER.**

MATERIALS.—*Squared paper ; lead pencil ; scissors.* [*Copy of leaf outline.*]

[NOTE.—The squares on the paper used by the children should be quarter inches, but the teacher could get squared cardboard with inch squares on which to draw copies to be placed in front of the class. Some dried and pressed leaves of fairly large size and simple shape would be useful in this and some of the following exercises.]

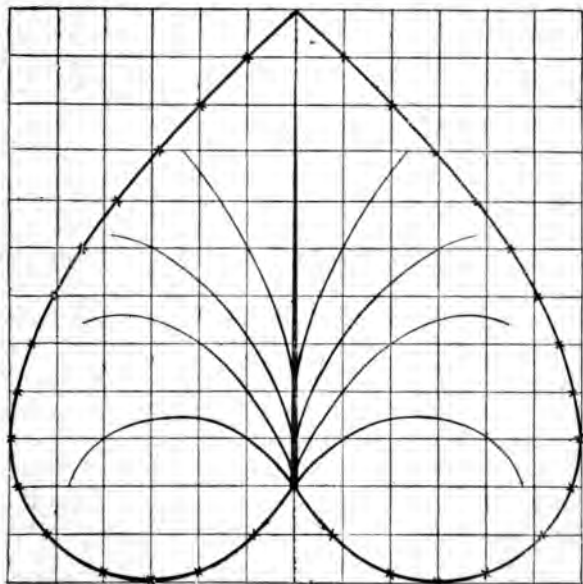
Draw lightly a square of three inches (twelve small squares) side on the squared paper.

Draw lightly the middle line from top to bottom of square.

Copy outline of leaf by help of squares (first marking points where outline crosses each line of squares).

Cut out with scissors when neatly drawn.

Mark in midrib and some of the veins.



Exercise XXIII.**PAPER CUTTING—LEAVES.**

MATERIALS.—*Small white paper square; coloured paper square; ruler; lead pencil; scissors. [Pressed and mounted or fresh leaves.]*

Find middle points of two opposite edges of white square, and rule line joining the two points.

Draw from actual leaf, or from copy drawn on blackboard, outline of one side of simple leaf (Fig. 1).

Fold paper carefully along middle line (with drawing outside), and press down flat.

Cut through the doubled paper along the drawn curve.

Open out the piece cut to show form of leaf, and mark with pencil midrib and some veins.

Proceed in same way as above on back of coloured paper to draw outline of somewhat differently shaped leaf (Fig. 2), and cut out.

NOTE.—In repeating the Exercise, the children might try to reproduce the general outlines of some simple mounted leaves (see figures on p. 47).

FIG. 1.

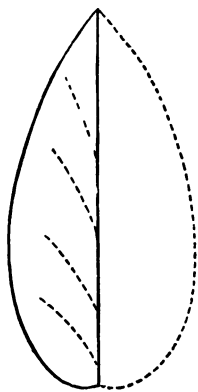
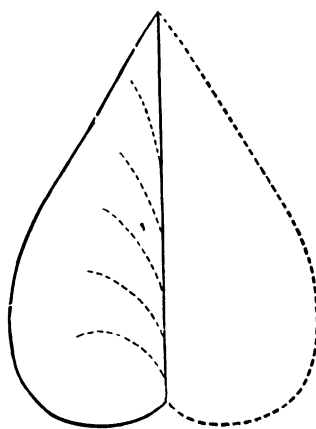


FIG. 2.



Exercise XXIV.**PAPER CUTTING AND MOUNTING (PLATE II.).**

MATERIALS.—*Large white paper square ; small white paper square ; coloured gummed paper square (green by preference) ; scissors ; ruler ; lead pencil ; damp sponge. [A mounted clover leaf would be useful to suggest the general arrangement.]*

Fold and cut the two small paper squares along middle lines, each into four squares (Fig. 1).

On one small white square outline and cut leaf (Fig. 1), as in Exercise XXIII, from copy on blackboard.

Repeat this drawing and cutting on the other small white squares till a well-shaped leaf is obtained.

With the best-shaped white leaf as pattern cut out three coloured leaves.

Lay the coloured leaves on the large square to form pattern of compound leaf, and mount in position (Fig. 2).

Outline a simple stalk with pencil, or cut out a curved coloured strip, and mount (Plate ii. Fig. 2).

FIG. 1.

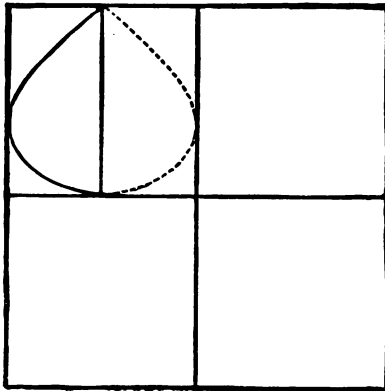
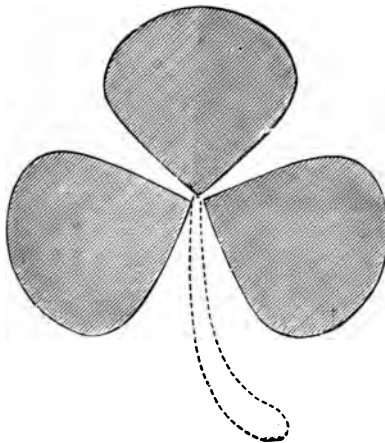


FIG. 2.



Exercise XXV.**WIRE MODELLING.**

MATERIALS.—*Piece of thin wire about twenty inches long* (see Note F, p. 5); *rule*; *scissors*; *slate and pencil*.

Straighten out wire, if necessary, and measure total length in inches.

Make wire into small coil without twisting the end.

Draw with rule on slate letter **L**, having longer arm two inches and shorter one inch.

Cut off piece of wire required to make letter **L** same size, straighten and bend at right angles. (In bending the wire, hold tightly between thumb and forefinger, and bend over thumb-nail.)

Rule figure on slate similar to Fig. 2, each line being one inch long.

Calculate length of wire required to make similar figure, cut off, straighten, and bend at proper points.

Rule letter **V** on slate, each arm being two inches long.

Cut off length of wire required to make same letter, straighten and bend at middle point. (It will not be possible to make a very sharp bend at the angle, but the sides of the **V** should be kept straight.)

Lay the wire models over the drawings to see if they agree.

(With the remaining piece of wire the children might be allowed to make any other letter or object they pleased, first, however, drawing the figure on their slate.)

FIG. 1.

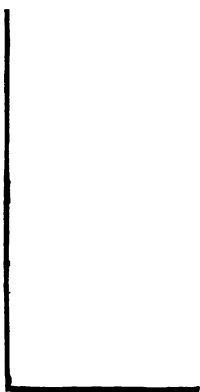


FIG. 2.

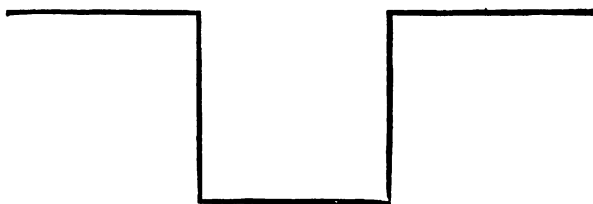
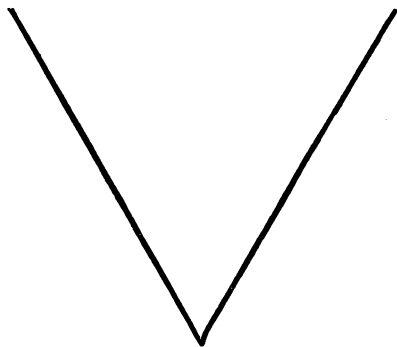


FIG. 3.



Exercise XXVI.**WIRE MODELLING—LETTERS.**

MATERIALS.—*Coil of thin wire (or piece at least two feet long); scissors; rule; piece of white paper to lay wire on.*

Cut off four pieces of wire each six inches long, and straighten out.

Draw one piece between finger and thumb (or over slate frame) to give it a curved form, and model it into shape of C with small loop at end. (Make it so as to lie flat on desk.)

Estimate middle point of second piece; hold at estimated middle point and test with rule.

Bend each half of this second piece into curve to form letter S. Find middle point of third piece as before, and bend at right angles there.

Bend half of the third piece into curve to form P twisting end round straight piece to fasten it.

Hold fourth piece at point, so that one part is twice as long as other, and test with rule; bend sharply at right angles there.

Bend longer portion of this fourth piece to form R; then convert to B.

C S

P R B

Exercise XXVII.**WIRE MODELLING—LEAVES.**

MATERIALS.—*Piece of wire about thirty inches long ; rule ; scissors.*

Measure length of wire, and cut into lengths of six inches.

Draw wire between finger and thumb, or over slate frame, to give it a curved form.

Make one piece into a circle, as nearly as possible, fastening the ends by twisting them together.

With two other pieces make the outline of leaves of same shape as in Exercises XXII. and XXIII. (This might first be attempted from memory, and then if necessary from copy drawn on blackboard.)

Attach small piece of wire to leaves to represent stalks.

Make fourth piece of wire into object chosen by children themselves.

Exercise XXVIII.

CLAY MODELLING—LEAVES.

MATERIALS.—*Moist clay ; modelling board ; damp sponge ; modelling tool.*
(See Note H, p. 7.)

Divide clay into two approximately equal pieces.

Flatten out clay on board with fingers into approximate shape
(and size) of one of the leaves of Exercise XXIII.

Finish off shape of leaf by aid of modelling tool.

Attach simple stalk, and mark in veins.

Similarly model other leaf of Exercise XXIII., or copy simple
dried and mounted leaf shown.

NOTE.—A further exercise to model the group of three simple leaflets of
Exercise XXIV. might follow the present one.

Exercise XXIX.

PAPER MOUNTING—CHIEF POINTS OF COMPASS (PLATE I.).

MATERIALS.—*Large white paper square ; three differently coloured gummed squares (to go well together, one being light coloured for central square); rule ; scissors ; lead pencil ; damp sponge.*

Find middle point of each edge of large paper square by means of rule, and mark.

Rule faint pencil lines joining opposite marked points ; also rule faintly the diagonals.

Mount one gummed square symmetrically, with corners on ruled diagonals of large square and sides parallel.

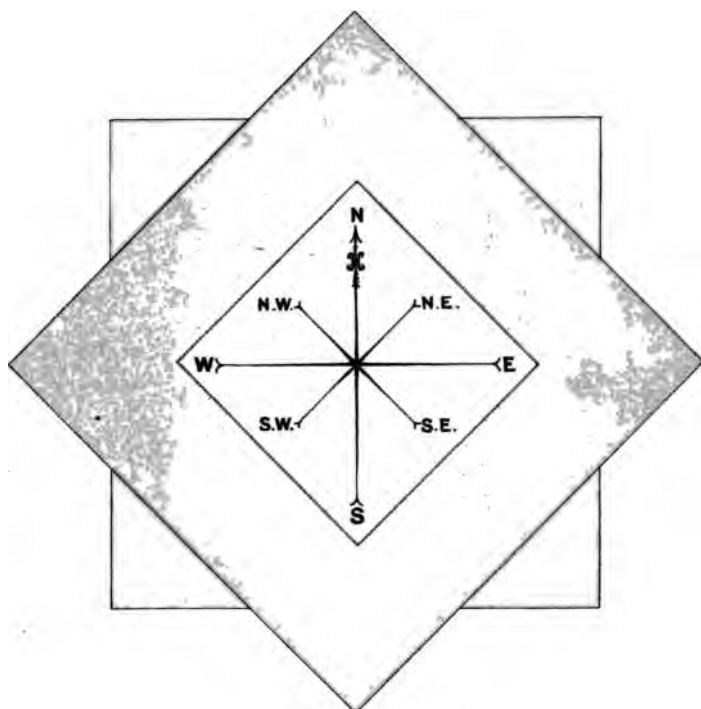
Mount second gummed square symmetrically over first, but with corners on ruled middle lines of large square.

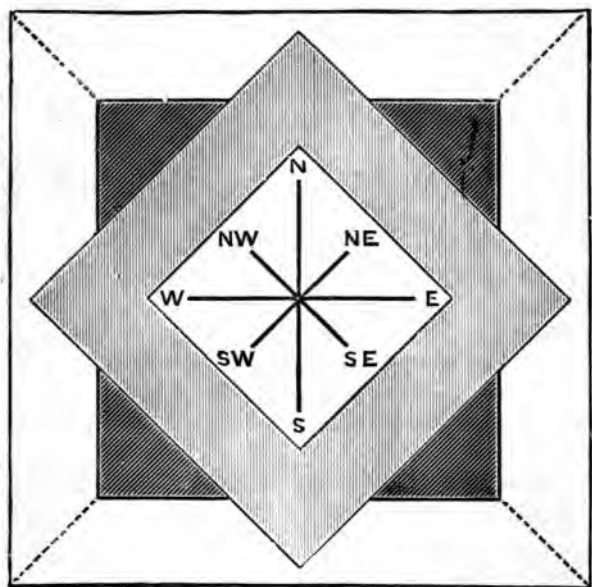
Carefully fold third (light) coloured gummed square along middle lines to form four small squares. (One light-coloured square might therefore serve for four children.)

Mount small light-coloured square symmetrically in centre of, and with sides parallel to, last mounted square.

Rule lines on central square in direction of its diagonals, and also in direction of diagonals of first mounted square ; leaving space sufficient for printing in letters N, E, S, W. (Print also letters for intermediate points N.E., N.W., S.E., S.W., if children understand them.)

Plate I.





Exercise XXX.**DRAWING, PAPER-CUTTING AND MOUNTING.**

MATERIALS.—*Large white paper square ; three differently coloured gummed paper squares ; squared drawing paper ; lead pencil ; scissors ; damp sponge.*

Draw on squared drawing paper from dictation a square with $3\frac{1}{2}$ inches (14 squares) side.

Draw lines joining middle points of sides of square thus drawn.

Draw smaller square inside and with sides parallel to those of second. (The position of this third square might be left to the children themselves to determine ; or they might be told to make its corners at a distance of three squares from the corners of the second square.)

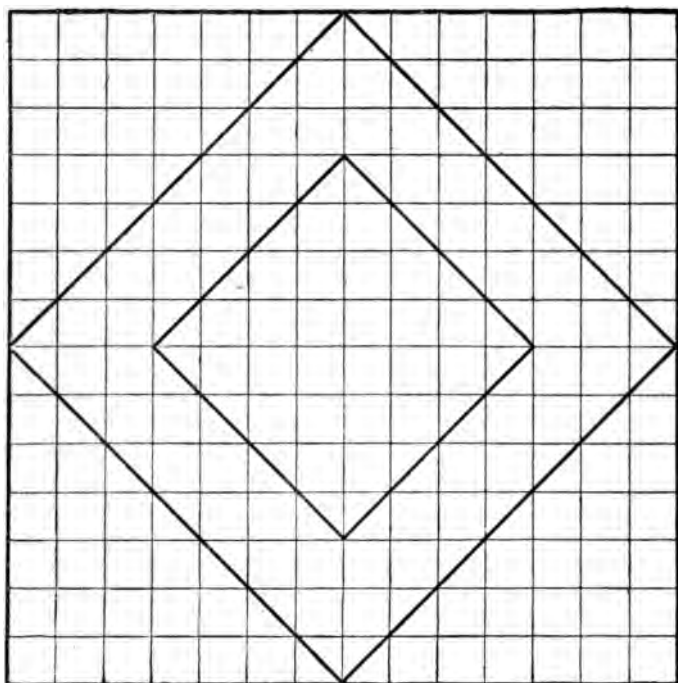
Cut out largest square from the drawing, and, using it as a pattern, cut similar piece from one of coloured squares.

From the large square first cut from the drawing, cut out next largest square, and use it as a pattern to cut similar piece from second coloured square.

Repeat same steps with smallest square.

Lay coloured squares so cut out over each other on white square, so as to reproduce the pattern of the drawing.

Mount the coloured squares in position.



SECOND SERIES.

LIST OF APPARATUS AND MATERIALS.

[Those marked with * are the same as used for the First Series.]

- * Large white paper square, 6" side.
- Sheets of white paper (or leaves of ordinary exercise-book),
8" \times 6".
- * Paper strips, 12" long by $\frac{1}{2}$ " wide.
- Plain white cards, $4\frac{1}{2}$ " \times 3".
- * Squared drawing paper (quarter-inch squares), pieces 5
square.
- * Coloured (various) paper squares, 4" side, gummed on back.
(*Note D, p. 4.*)
- Boxes of crayons, with holders and stumps. (*Note I, p. 68.*)
- * Thin soft copper wire, No. 26 gauge. (*Note F, p. 5.*)
- Short *wide* wooden laths, 5" \times $\frac{3}{8}$ ".
- * Modelling clay. (*Note G, p. 6.*)
- * Modelling board.
- * Modelling tool. (*Note H, p. 7.*)
- * Earthenware vessel with lid, for holding moist clay.
- * Smooth square wood blocks, for rolling clay, 3", by $\frac{1}{2}$ " thick.
- * Rule, 12" long (marked to quarter-inches).
- * Lead pencil.
- * Scissors. (*Note C, p. 4.*)
- * Circular disc, 3" diameter, by preference of metal.
- * Square disc, 3" side, by preference of metal.
- * Series of various-coloured wools in bag. (*Note E, p. 5.*)
- * Teacher's corresponding series of wool skeins.
- * Thin string, for cutting clay.
- Drawing pins.
- * Small sponges.

NOTES ON THE APPARATUS AND MATERIALS, AND THEIR USE.

The notes which follow the list of apparatus and materials for use in the First Series of exercises should be consulted.

- (1) The boxes of *crayons* should contain several (say six) different colours, so that the children may have an opportunity of selecting various combinations according to their tastes.

The crayons may be had enclosed in wood like ordinary lead pencils, but this would involve considerable trouble in sharpening them. It is perhaps best, on the whole, to supply the crayons in short pieces, and to supply also a simple holder for the crayons in order that even very small pieces may be utilized.

In using the crayons, they are first lightly rubbed over the space to be coloured so as to cover it fairly and evenly, and then the crayon powder is rubbed smoothly over the paper with a stump or rubber of leather or soft paper. A separate stump should be kept for each colour. A piece of tissue paper folded several times does very well for rubbing on the powder, but specially prepared paper stumps are to be preferred. (Messrs. Philip, Son, and Nephew, South Castle Street, Liverpool, supply cheap boxes of crayons, with a holder and stump for each colour.)

The crayons should work free from gritty particles, and *should* be kept in a dry place.

Exercise I.**LAYING AND FIXING LATHS.**

MATERIALS.—*Four short wide wooden laths; piece of coloured gummed paper (half ordinary square); scissors.*

Test laths to see that all are of same dimensions. (Note breadth as well as length.)

Lay laths to form square (Fig. 1). (See that all angles are right angles.)

Lay again to form square (Fig. 2), with ends equally projecting about $\frac{3}{4}$ ", without measurement. (When the latter operation is correctly performed, the laths might be temporarily fastened together, so as to be taken up in the hand, as follows :—)

Fold coloured gummed paper into two squares, and cut one square into eight equal strips.

Fasten one paper strip at each corner across the lath lying uppermost.

Fasten second strip across first symmetrically. (This is done only for the appearance.)

Cut more strips of gummed paper and fasten the laths on the reverse side, in the same manner as before.

FIG. 1.

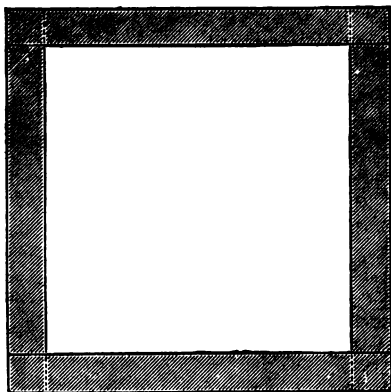
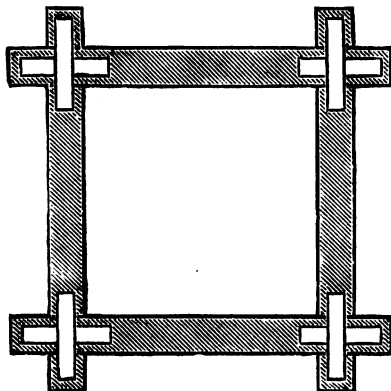


FIG. 2.



Exercise II.**PAPER CUTTING AND MOUNTING.**

MATERIALS.—*Large white paper square ; coloured gummed square ; rule ; pencil ; scissors ; damp sponge.*

Fold coloured square accurately down middle line (coloured side inwards) and crease well. (*See Note D, p. 4.*)

Cut carefully with scissors along creased line. (*See Note C, p. 4.*)

Fold each half again lengthwise, crease, and cut.

Fold each piece again lengthwise, crease, and cut so as to get eight equal strips.

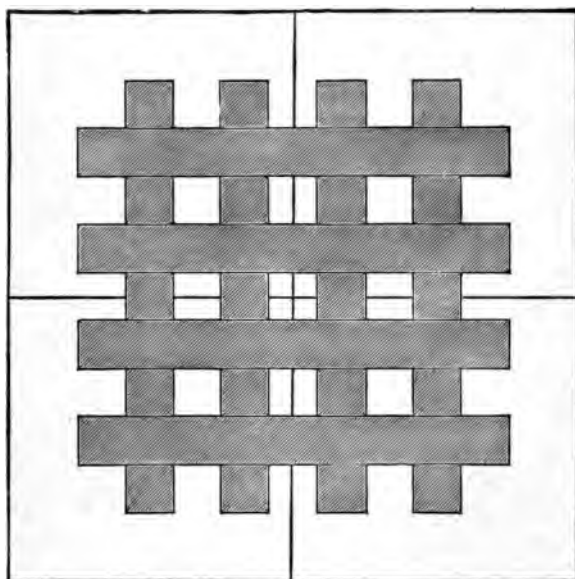
Find middle point of sides of white square and rule faint lines joining opposite points.

Mount two strips on opposite sides of, and parallel to, middle line, leaving space between strips about equal to width of one strip (see figure).

Mount two other strips parallel, one on each side former, and at equal distance.

Mount other four strips across in similar manner.

Note nine equal small squares.



Exercise III.**CUTTING PAPER STRIPS TO SIZE.**

MATERIALS.—*Paper strip at least 12" long ; scissors ; rule ; lead pencil.*

Measure strip, and, if necessary, cut to make it exactly 12" long. Mark point one inch from end of strip, fold there and cut off piece one inch long.

Fold down piece twice as long as last (by estimation) ; test it with rule, correct, and cut off.

Lay end to end pieces 1" and 2" long, and fold down piece 3" long by estimation ; test, correct, and cut off.

Calculate length of remaining portion of strip and test.

From longest strip cut off piece half-inch long by measurement.

Cut off another half-inch from strip by estimation.

Cut off by estimation (judging by appearance of pieces already cut) pieces respectively 1", 2", and $1\frac{1}{2}$ " long, and test them by the rule.

Lay all the pieces in order of size, and state length of any one pointed out. (The length might be written in pencil on each piece, instead of merely requiring them to state the length of a piece when pointed out.)

Exercise IV.**PAPER CUTTING AND MOUNTING.**

MATERIALS.—*Large white paper square ; coloured gummed square ; circular metal disc ; scissors ; rule ; lead pencil ; damp sponge.*

Draw outline circle (by tracing round disc) on back of gummed square. (See that sharp point of pencil is kept close to edge of disc.)

Carefully cut out the outlined circle.

Cut two narrow strips (about $\frac{1}{4}$ " wide) from sides of coloured paper left from previous cutting.

Fold circle along one diameter, crease, and cut. (Note equality of semicircles.)

Fold each semicircle into two equal parts (quadrants), crease, and cut.

Rule lines parallel to sides of large paper square at distance of 1" (by measurement).

Rule faintly diagonals of inner square.

Mount the two narrow coloured strips along the diagonals, crossing at their centres.

First lay, and then mount, each coloured quadrant, touching sides of ruled square, and with point on middle line of coloured strip (Fig. 1).

NOTE.—A variation of this exercise is suggested in Fig. 2, where the outlined circle is folded and cut into eight equal sectors, and these are mounted symmetrically along diagonals and middle lines of square.

FIG. 1.

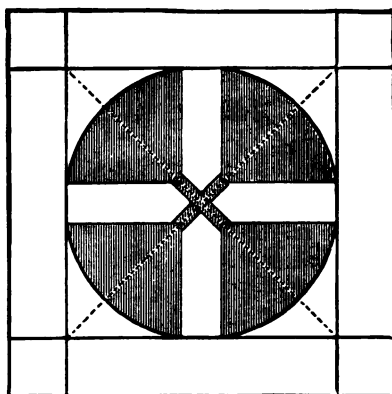
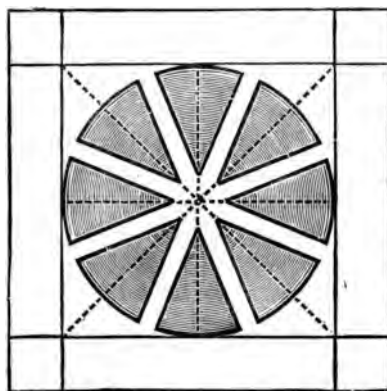


FIG. 2.



Exercise V.**FOLDING AND TEARING PAPER TO SIZE.**

MATERIALS.—*Large white paper square ; rule ; lead pencil ; scissors.*

Measure paper square, and state size.

Mark points on opposite edges of square at distance of 1" from corners, and then fold down strip 1" wide.

Crease strip well, and tear off neatly.

Mark points 1" from one end of strip, fold down there (thus forming square inch), crease, and tear.

Measure all sides of square inch, and write words "square inch" on it.

Fold remaining portion of same strip, without measurement, to form another estimated square inch ; crease, tear, and compare with first.

Fold remainder of strip into square inches.

Mark points on opposite edges of original paper distant 2" from corners ; fold down strip 2" wide, crease, and tear.

Mark points 2" from one end of strip ; fold down there (forming piece two inches square), crease, and tear.

Compare latter square with square inch previously torn, and fold to show that it contains four square inches.

Fold without measurement, on same strip, another piece 2" square ; tear and test.

From remainder of large square, cut (or tear), without folding or measurement, pieces 1" and 2" square respectively, and compare with those previously made.

Exercise VI.

COLOUR SORTING.

MATERIALS.—*Series of coloured wools in bag; large white square to lay wools on.* [Teacher's corresponding series of wool skeins.] (See Note E, p. 5.)

Children select coloured wool to match colour of skein shown by teacher.

Select best red, orange, yellow, green, and blue, and lay in that order.

Lay bright blue in middle of paper, then lighter and lighter tints, grading into white.

On other side lay darker shades of blue, grading to black.

Lay red and yellow at distance apart, and lay several intermediate tints in order.

Lay series similarly between green and yellow, or green and blue.

Lay together, or twist together loosely, pairs of colours which form pleasing combination.

NOTE.—This lesson should be repeated several times at intervals.

Exercise VII.**DRAWING AND COLOURING.**

MATERIALS.—*Sheet of squared paper ; ruler ; lead pencil ; crayons (with holders and stumps).* (See Note I, p. 68.)

Rule lines at equal distance (say one small square) from each edge of square sheet, to form a border.

Rule faintly smaller square, parallel to border lines, say two squares distant. (Let children as far as possible rule these lines from verbal instructions, rather than from copy.)

Rule faintly diagonal square from points opposite middle points of sides of last square, and one square distant.

Rule faintly small oblong, say seven squares by three squares, symmetrically within last-ruled square. (See figure.)

Colour the two squares with two crayons (choosing colours which harmonize), and rubbing colour evenly with stumps.

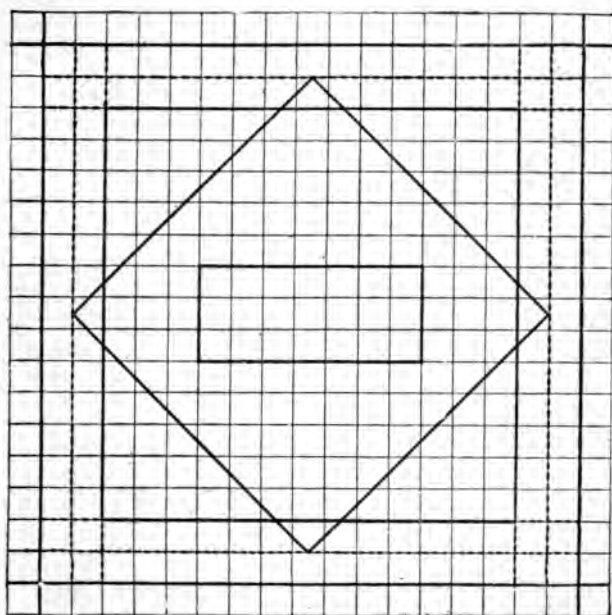
Leave the oblong space uncoloured.

Rule strongly in pencil the lines bordering the colours.

Let each child write his name in the central uncoloured space.

[If there is time, a strip one square wide (shown by dotted lines in figure), outside the first drawn square, might be shaded with black-lead pencil.]

NOTE.—This exercise might be repeated on a plain white paper square, the children outlining the two squares to be coloured by means of the model metal squares.



Exercise VIII.

DRAWING AND COLOURING.

MATERIALS.—*Squared paper ; ruler ; lead pencil ; crayons (with holders and stumps).*

Rule border lines one square distant from edges of paper.

Rule faintly inner square parallel to border lines, and two small squares distant.

Count number of small squares along one side of ruled square, and mark points enclosing the three central small squares on each of the four sides.

Rule faintly lines joining opposite marked points, to form a broad cross.

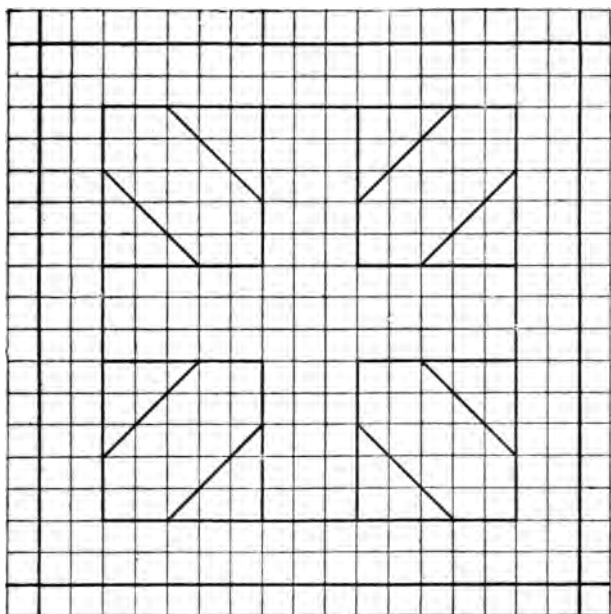
Mark points on sides of ruled square distant two small squares from each corner, and rule faintly lines joining opposite points to form diagonal cross.

Colour first cross with crayon rubbed evenly with stump.

Colour diagonal cross with crayon of different colour, but harmonizing with the first.

Rule strongly the lines bordering the colours.

NOTE.—Several interesting exercises may be arranged, in which the Union Jack and various other flags may be drawn and coloured.



Exercise IX.**FOLDING AND TEARING PAPER SQUARES.**

MATERIALS.—*Paper 8" × 6" ; rule ; lead pencil.*

Estimate length of sides of paper, then measure. (The children might first write down their estimate before measuring.)

Measure, fold, and tear a strip one inch wide off one of longer edges.

Measure remaining paper, and state size, viz. 8" × 5".

Fold paper carefully along line A D, bringing point B to edge of paper at C, and making side A B coincide with A C (Fig. 1). Crease to keep it folded there.

Fold down remaining piece along line C D ; crease and tear.

Measure sides of piece A B D C to prove that it is a square.

Fold down and tear off square in similar manner from piece C D F E ; then again from remaining piece another square, and so on, to get four squares. (Note if children have observed that piece then remaining is also a square.)

Measure sides of each square, and write dimensions on each side, *e.g.* "5 inch square," etc.

Straighten out squares, and lay together to form original piece.

Lay squares symmetrically one on another (Fig. 2).

FIG. 1.

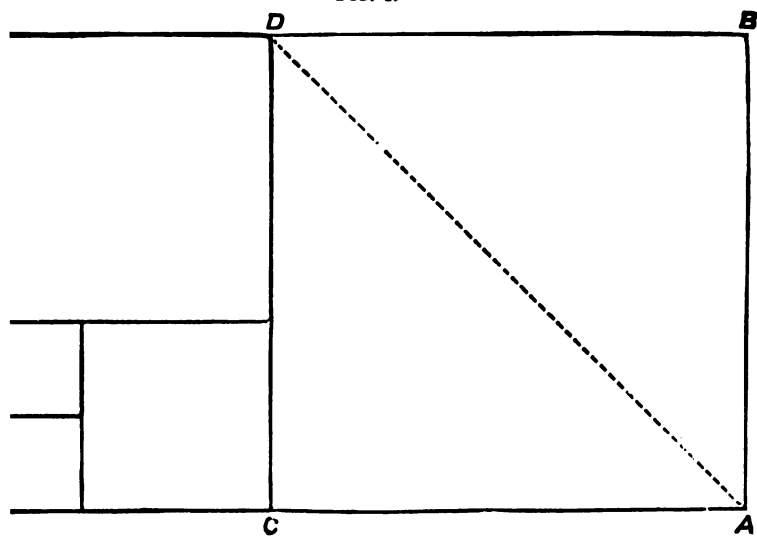
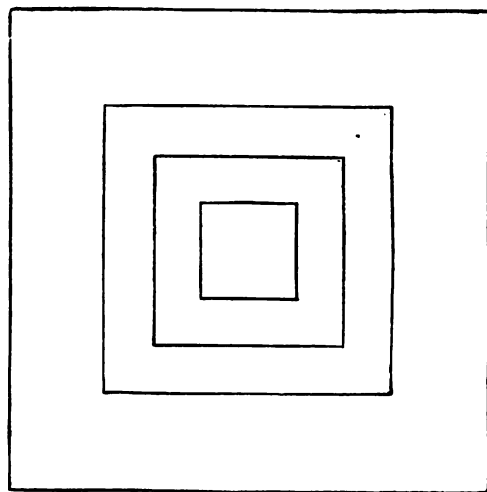


FIG. 2.



Exercise X.**DRAWING AND COLOURING.**

MATERIALS.—*Large white paper square ; ruler ; lead pencil ; model circular disc and square ; crayons.*

(First note that diameter of circular disc is equal to width of model square.)

Lay metal square symmetrically in centre of and with sides parallel to paper square ; and draw the outline.

Lay circular disc symmetrically inside drawn square, and draw its outline.

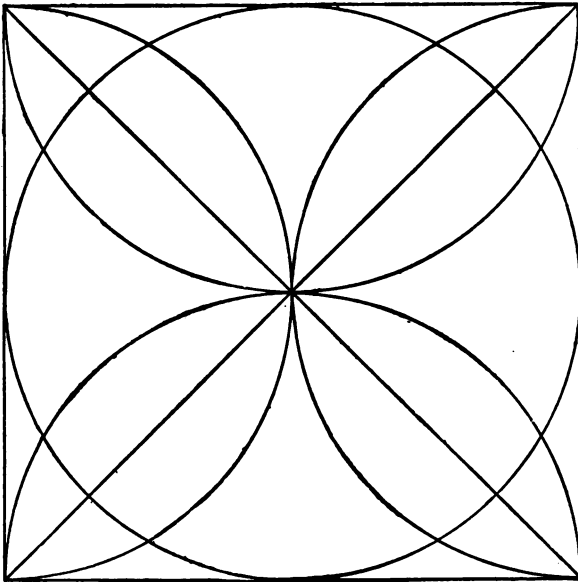
Rule faintly the diagonals of the drawn square, and note that they cross in the centre of the circle. (All the lines in this exercise should be drawn very accurately.)

Lay circle across one side of square, so as to touch other two sides of square and central point, and draw the semicircle (see figure).

Draw semicircle in same manner on each of the other three sides of the square.

Colour with crayons of three colours : viz. the curved arms of cross with one colour, the rest of the circle with a second, and the remaining portions of ruled square with a third.

· Rule strongly the lines bordering the colours.



Exercise XI.**WIRE MODELLING.**

MATERIALS.—*Thin wire 18" long (or coil of wire from which to cut lengths) ; scissors ; rule ; squared paper ; pencil.* (See Note F, p. 5.)

Draw on squared paper, from dictation, letter E (Fig. 1), extending over same number of squares as shown.

Measure (or calculate) length of wire required to make similar figure ; and cut off that length from piece supplied.

Bend wire at proper points as sharply as possible at right angles. (Note the double piece in the centre.)

Lay bent wire on drawing to test correctness.

Draw on the squared paper the form shown in Fig. 2 to dimensions given.

Measure and cut off length of wire required to form similar figure.

Bend wire at proper points at right angles.

Slightly open out angles to make them like those in the drawing. (Lay the wire as first bent on the drawing, hold down each part in succession on the drawn line while the next succeeding part is moved to its proper position.)

Lay the wire on the drawing to test correctness. (If it is desired to fix either figure in position, little narrow strips of gummed paper may be stuck over two or three of the arms.)

FIG. 1.

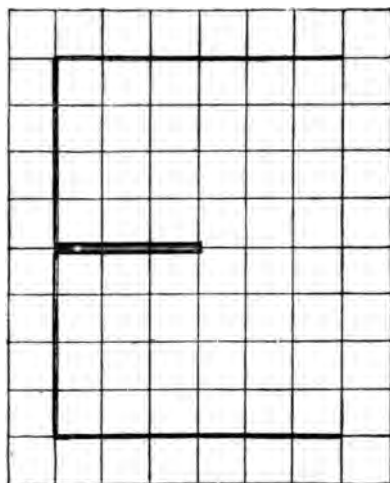
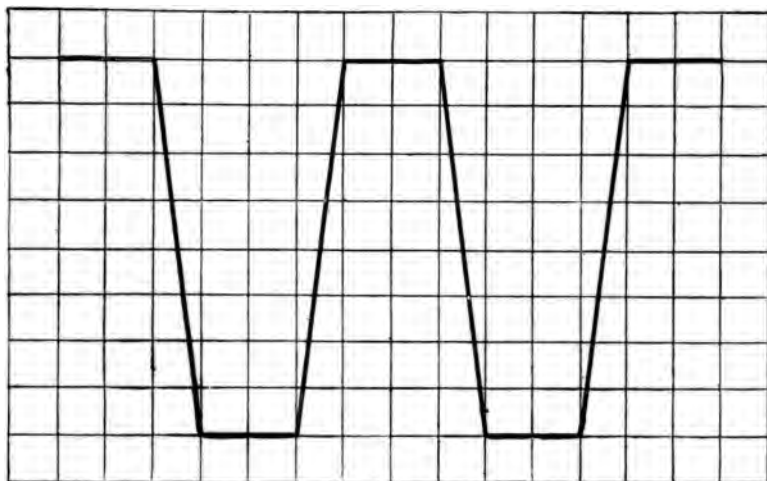


FIG. 2.



Exercise XII.**WIRE MODELLING.**

MATERIALS.—*Wire 17" long (or coil from which to cut lengths) ; scissors ; rule ; squared paper ; pencil.*

Draw (with ruler) on squared paper a square with $2\frac{1}{2}$ inches (ten small squares) side.

Draw also a triangle (equilateral), first ruling line **eight small squares** long, and joining **each end of this line** with point opposite middle of line and seven squares distant.

Calculate length of wire required for square similar to drawing, allow half-inch over, and cut off length from coil.

Bend aside the extra half-inch (to be used for holding or fastening) ; estimate middle point of remaining piece ; test, correct, and bend sharply there at right angles.

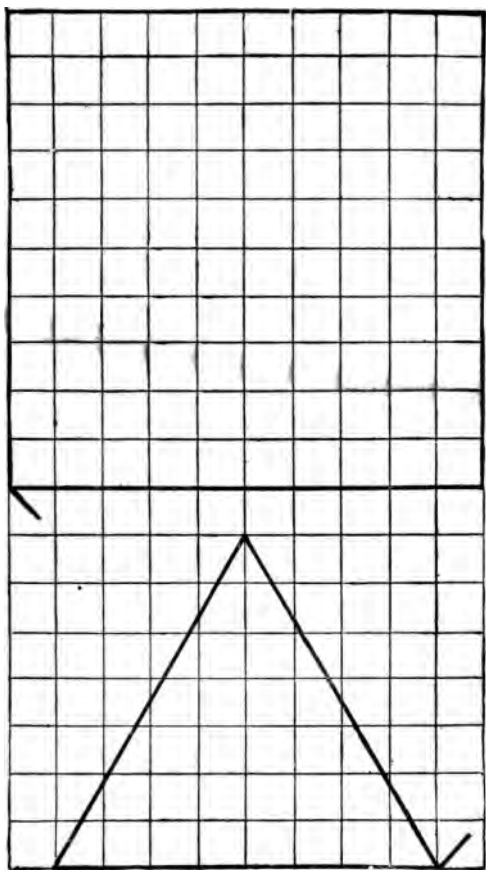
Estimate middle point of each half, test, correct, and bend sharply there at right angles to complete square.

Hold square by extra piece for inspection (or bend latter piece outwards, so as to enable square to stand upright alone).

Calculate length of wire required for triangle similar to drawing, allow half-inch over, and cut piece to proper length.

Bend aside extra half-inch ; estimate points at which wire must be bent ; test, correct, and bend to form triangle.

Compare wire models with drawings.



Exercise XIII.**PAPER CUTTING AND MOUNTING (PLATE III.).**

MATERIALS.—*Large white paper square; coloured gummed paper square (each pair of children having different colours which harmonize); ruler; pencil; scissors; damp sponge.*

Fold square accurately along middle line, bringing opposite edges together, and crease.

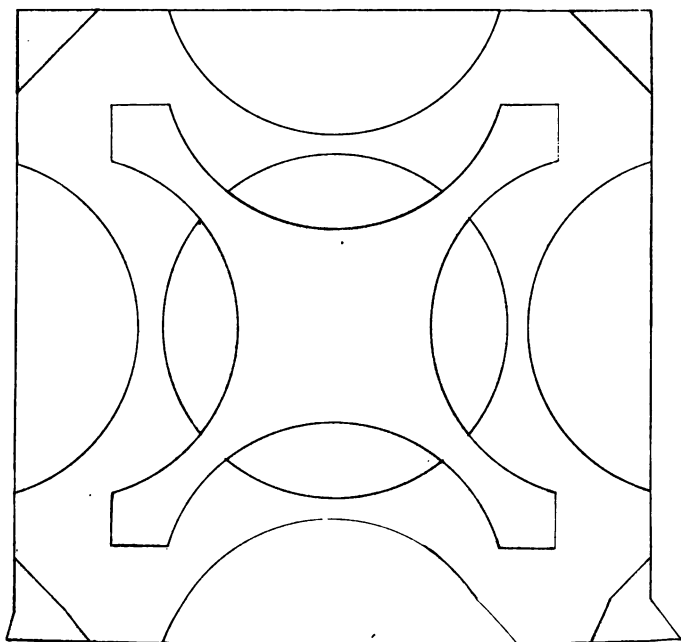
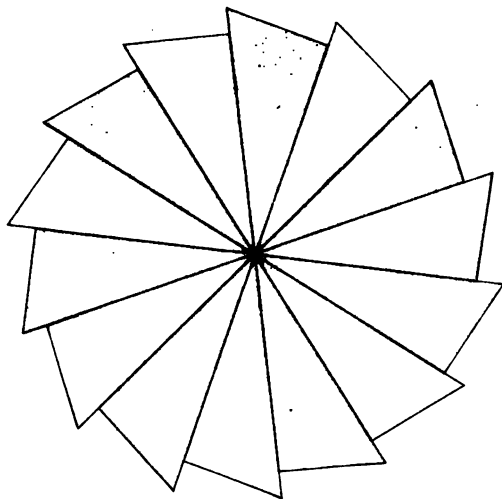
Open out square and cut carefully along middle line. (The ruling and cutting must be very carefully done to get a good result.)

Change one piece with neighbour for piece of another colour.

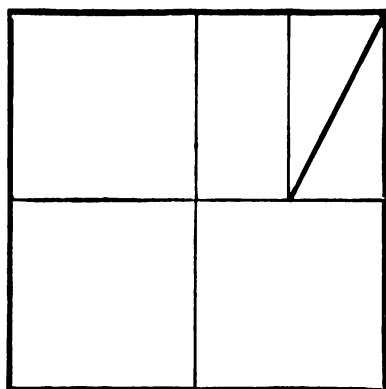
Double each piece to get from it two small squares (see figure); then each square to get two equal oblongs.

Rule one diagonal on each oblong (taking care to rule same one in each case), and cut carefully along ruled line.

Mount the triangles (of the two colours alternately) with their sharp angles meeting in centre of large paper square (Plate iii. Fig. 1).







Exercise XIV.**CLAY MODELLING.**

MATERIALS.—*Moist clay (enough to form ball about 2" diameter) ; modelling board ; small square wooden block ; damp sponge.* (See Note G, p. 6.)

Roll clay on board, and with both hands, to form sphere.

Roll clay sphere on board with block to form short cylinder with flat ends, and set upright on one end.

Roll cylinder to form pointer-like rod tapering to blunt point at one end.

Roll out again to uniformly thick rod, flatten and mould into shape of figure 6.

FIG. 1.

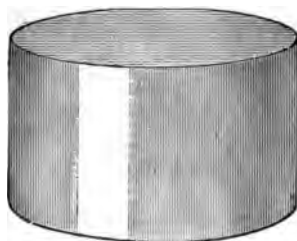
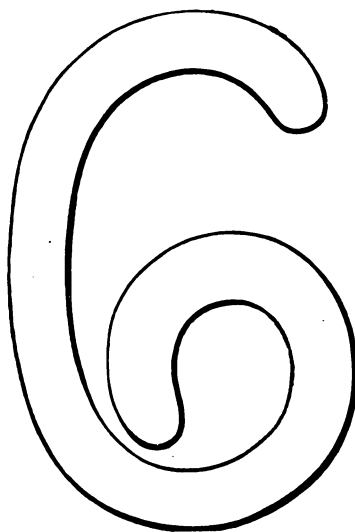


FIG. 2.



FIG. 3.



Exercise XV.**CLAY MODELLING.**

MATERIALS.—*Moist clay ; modelling board ; modelling tool ; damp sponge.*
(See Note H, p. 7.)

Roll clay into cylinder ; cut cylinder into three equal pieces.
Roll each piece into form of sphere ; compare sizes of spheres.
Model one piece into shape of solid hemisphere (like half-orange).
Model second piece into hemispherical cup.
Children model third into any form they please.

Exercise XVI.**CLAY MODELLING.**

MATERIALS.—*Moist clay ; modelling board ; modelling tool ; damp sponge.*
[*Egg and, if possible, acorn as models.*]

Divide clay into two equal-sized pieces, and roll each into sphere.

Model one piece into shape of egg. (Examine egg to note how its shape differs from that of sphere.)

Make other piece into shape of cup to fit larger end of egg.

Place egg in cup and slightly alter its form to represent an acorn (copying from actual specimen or from drawing).

Mark outside of cup (by pressing end of modelling tool into it) to represent rough surface of acorn-cup.

FIG. 1.

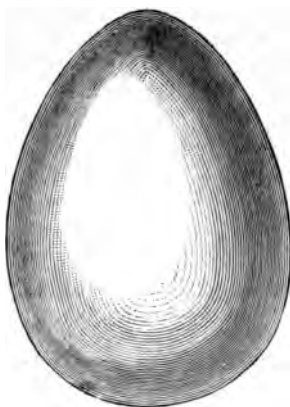
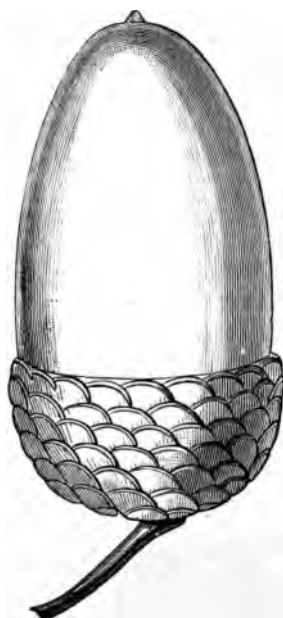


FIG. 2.



Exercise XVII.**DRAWING AND PAPER-CUTTING.**

MATERIALS.—*Large white paper square ; model circle ; model square ; rule ; lead pencil ; scissors.*

Rule two lines joining middle points of opposite sides of paper square.

Lay model circle symmetrically in centre of large square and faintly trace its outline.

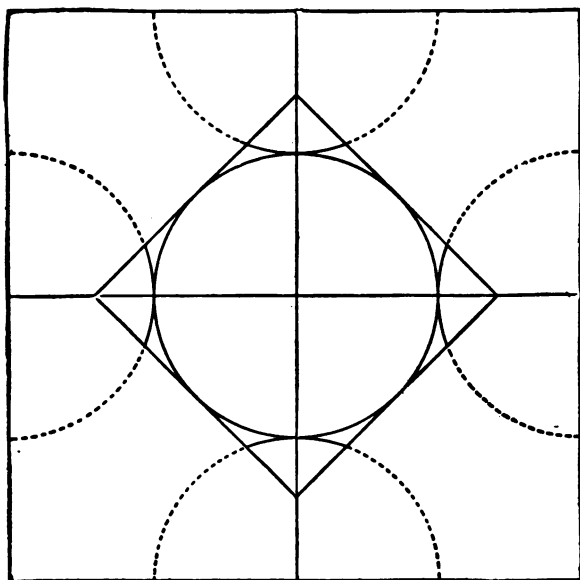
Lay model square symmetrically, with corners on ruled lines, and trace its outline. (Note that, if circle previously laid correctly, sides of square should just touch it ; if not correct, lay again inside square and trace outline strongly.)

Lay model circle symmetrically over each edge of square in succession, touching outline of circle previously drawn, and trace the four semicircles.

Cut carefully from edges of paper square along curved lines to meet sides of inner square (as dotted in figure).

Fold and crease the corner pieces along sides of inner square, and fold down over each other.

Fold down semicircles (as far as they are cut) in opposite direction to corner pieces (*i.e.* on to the other side of the large square).



Exercise XVIII.**DRAWING AND COLOURING.**

MATERIALS.—*Large white paper square ; model circle ; rule ; lead pencil ; crayons (with holders and stumps).*

Rule faintly the diagonals of the square.

Rule faintly border lines at equal distances (about $\frac{1}{4}$ ") from each edge of square, without measurement.

Rule faintly other lines parallel to last, and about $\frac{3}{4}$ " distant from each edge of square.

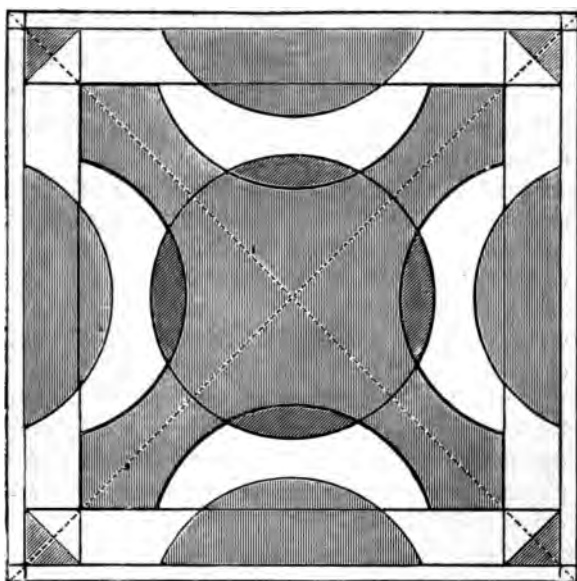
Lay model circle symmetrically in centre of square and trace outline.

Lay model circle symmetrically to form nearly a semicircle on each side of outer ruled square, and nearly but not quite touching inner circle.

Mark points on sides of inner square, at equal distances (about $\frac{1}{2}$ ") from corners, and lay model circle so as to trace arc joining pairs of points on same side (as in figure).

Draw one diagonal of small corner squares.

As a reward for careful drawing the children might be allowed, (in another lesson, if necessary), to colour the pattern with crayons of two different colours.



Exercise XIX.**PAPER CUTTING AND MOUNTING (PLATE III.).**

MATERIALS.—*Large white paper square ; two gummed paper squares of different colours ; model circle ; pencil ; scissors ; damp sponge.*

Carefully trace outline of model circle on the back of the darker coloured square, and cut out.

At the back of the other coloured square, mark points on sides at equal distances (about $\frac{1}{2}$ ") from each corner.

Lay model circle and trace arcs joining pairs of points on each side of square (as in last exercise).

Carefully cut out the curved pieces so marked.

From corners of first coloured square, cut off equal-sized corner pieces (as marked in last exercise).

Lay paper circle symmetrically (by estimation) in centre of large white square ; lay the cross symmetrically over circle diagonally in square ; and lay semicircles and corner pieces, so as to form altogether a pattern similar to that drawn and coloured in last exercise.

Mount the pieces in this position (Plate iii. Fig. 2).

Exercise XX.

ENVELOPE FOLDING.

MATERIALS.—*Squared paper ; pencil ; ruler ; scissors.* [*Envelope opened out as pattern.*]

(The teacher should show the class an envelope opened out,—note the number and relative sizes of its various parts, e.g. flaps fold to just beyond middle point of face, etc.)

Mark a point four squares from top of squared paper, and five squares from left side ; and from point rule along the horizontal line a line nine squares long.

Rule corresponding line six squares lower down, and join ends of two lines to form rectangle.

Calculate approximately the size of flaps required to fold over rectangle rather more than half-way.

Mark points opposite middle points of ends and five squares distant, and rule lines to corners of rectangle (Fig. 1).

Mark points opposite middle points of long sides, upper one four squares distant, lower one three squares and a half distant, and rule faint lines to corners of rectangle (dotted lines in Fig. 1). The advantage of having broad ends to the side flaps might be shown on the pattern envelope, and the ends in the drawing be made two squares wide (Fig. 1).

Cut out the form with scissors.

Fold carefully along the lines to form envelope.

Fold small strip of paper, and enclose in envelope.

NOTE.—It would be well to repeat this exercise, leaving the children as much as possible to themselves, or giving them the envelope made on the previous occasion ; and when they have ruled the lines, let them *modify them* as shown in Fig. 2.

FIG. 1.

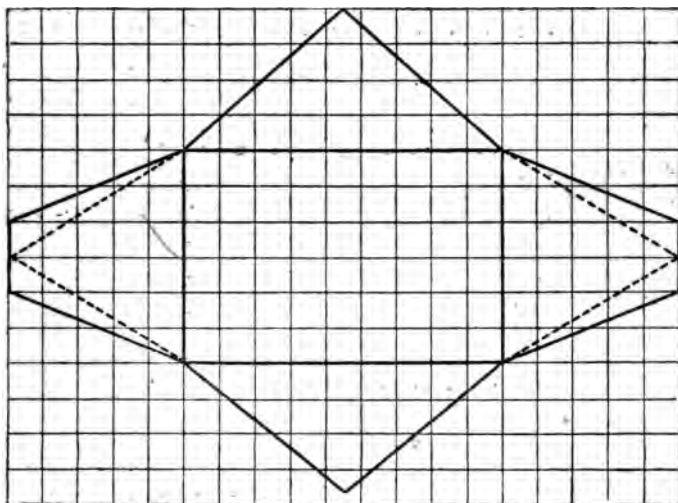
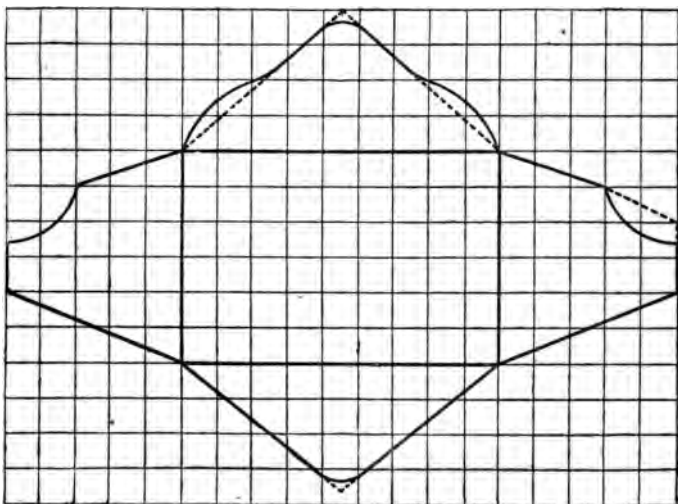


FIG. 2.



Exercise XXI.**ENVELOPE MAKING.**

MATERIALS.—*Large white paper square ; pencil ; rule ; scissors. [Oblong paper envelope (Fig. 1) opening at one end as pattern, or sketch of same on blackboard ; gum and brush.]*

(The teacher should show pattern envelope opened out, and note number, shape, and relative sizes of flaps, etc.)

Rule line faintly down middle of square.

Fold parts on each side of middle line so as to slightly overlap each other on middle line, and crease down.

Fold down top and bottom sides of square to form small bottom flap and larger top flap, and crease.

Cut out corner pieces (Fig. 2), and fold down flaps to make envelope or bag. (Note that the edges of the flaps are somewhat in each other's way.)

Rule line from middle point of top edge of upper flap to middle points of sides, and cut off corner pieces.

Rule lines (as dotted in figure), bevelling off edges, and cut along line with scissors.

Fold envelope again.

Gum down those which are well made.

FIG. 1.

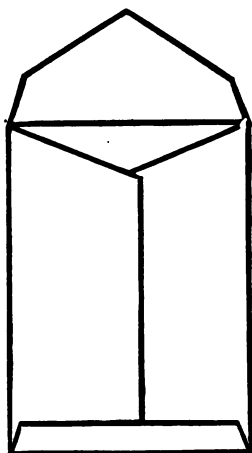
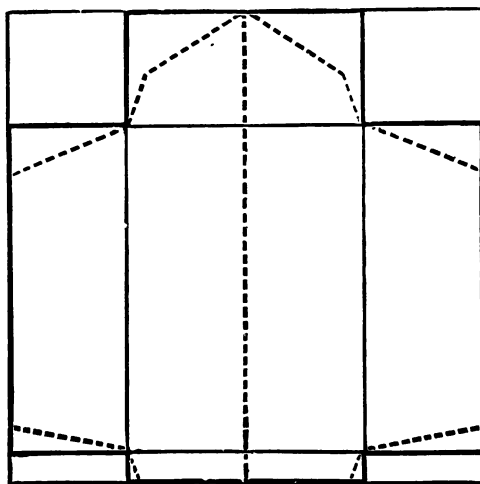


FIG. 2.



Exercise XXII.

CLAY MODELLING.

MATERIALS.—*Moist clay ; modelling board ; modelling tool ; small square wooden block ; damp sponge.*

(Set up drawing models, or else make a sketch on the board of the objects to be modelled.)

Divide clay into two equal-sized pieces.

Model one piece into square slab (about 2" in the side), working it with wooden block and tool, and being careful to make the angles sharp.

Roll other piece into cylinder about 2" long.

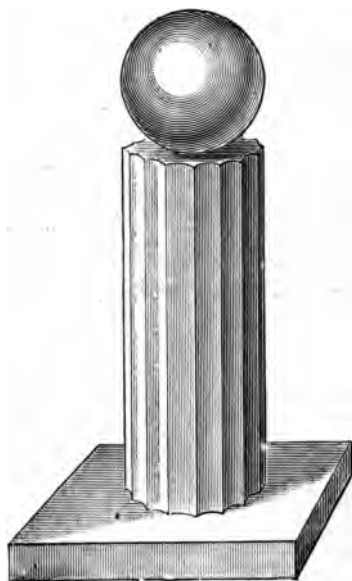
Set cylinder upright on centre of slab.

Cut off about one quarter of cylinder, and roll the piece to form a sphere.

Roll out the cylinder to about the same height as before.

Mount the cylinder on the square, and the sphere on the cylinder.

The sides of the cylinder might be fluted with vertical parallel grooves by means of the tool.



Exercise XXIII.**CLAY MODELLING.**

MATERIALS.—*Moist clay ; modelling board ; square wooden block ;
modelling tool ; damp sponge.*

*(Set in front of class a large vase, or bottle with straight sides, as
the object to be modelled.)*

Roll out the clay to form a short cylinder with flat ends, and
set it upright on the wooden block.

Model cylinder to shape of bottle or vase shown.

FIG. 1.

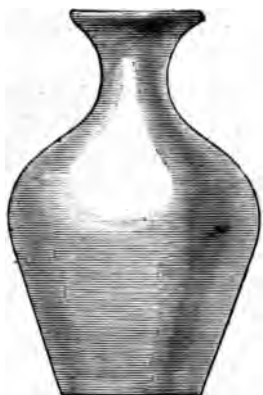
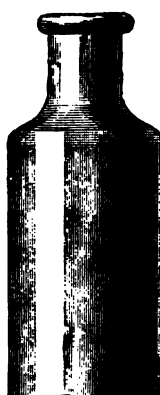


FIG. 2.



Exercise XXIV.**DRAWING AND COLOURING.**

MATERIALS.—*Plain white card ($4\frac{1}{2}$ " \times 3"); rule; pencil; crayons with holders and stumps.*

Rule lines at distance of quarter-inch from each edge of card.

Rule faint lines inside first, and at distance of half-inch from them, so as to make an oblong having sides 3" by $1\frac{1}{2}$."

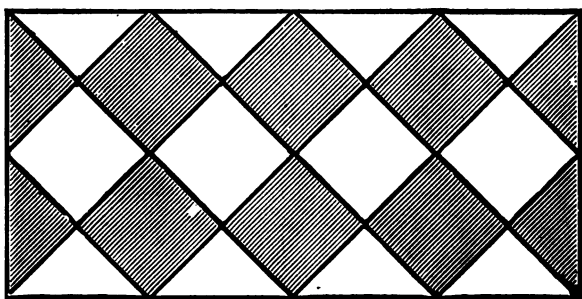
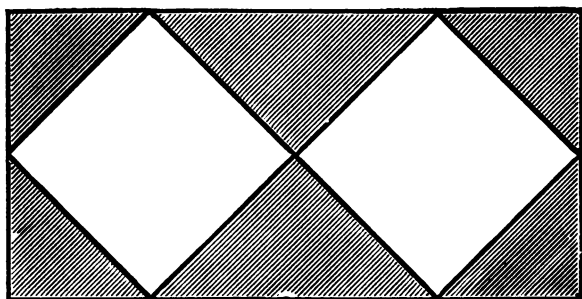
Divide sides of oblong by points at distance of $\frac{3}{4}$ " apart.

Draw lines faintly, either as in Fig. 1 or Fig. 2.

Colour with crayons of two colours, to form pattern. (The crayons will not "take" very well on the comparatively smooth surface of the card, but it is well that the children should find this out by actual experience.)

Rule in strongly the lines bordering the colours.

Each card should have the child's name written on it, and be kept for the next exercise.



Exercise XXV.**ENVELOPE MAKING.**

MATERIALS.—*Piece of paper 8" × 6" (a leaf of an ordinary exercise-book might be used); card from last exercise; scissors; ruler; pencil.*

Lay card symmetrically in middle of paper to indicate where to fold latter to make an envelope to hold the card.

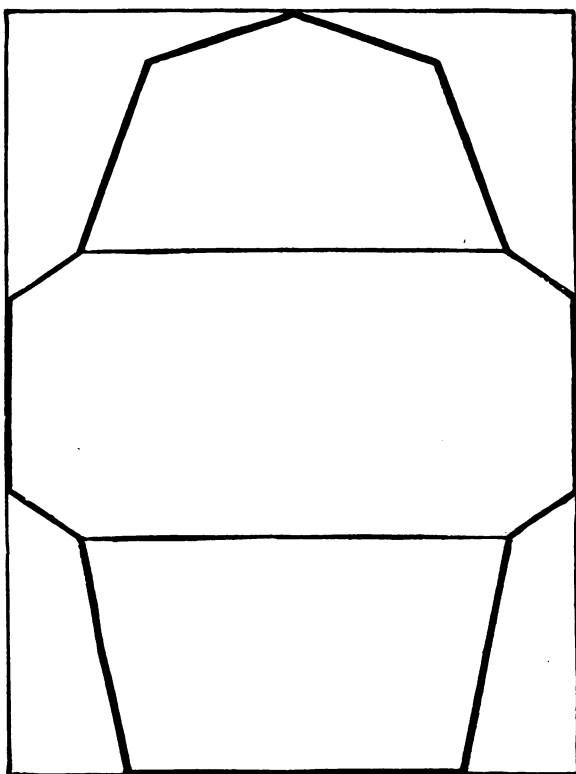
Rule lines parallel to and nearly touching edges of card.

Fold paper along those lines, and crease well.

[The rest of the exercise should be left almost entirely to the children themselves, to work out independently—suggesting to them, if necessary, to slope the edges of the flaps as in a previous exercise.

It will be observed that the side flaps in this case are not large enough to meet and overlap each other, as in the envelope previously made; the top and bottom flaps may therefore be made longer in proportion.

Well-shaped and folded envelopes might be gummed and fastened, the card enclosed, and the name of the child and the date written on the back.]



Exercise XXVI.**WIRE MODELLING.**

MATERIALS.—*Wire, about 12" long ; rule ; white paper square.*

Measure length of wire, after straightening it out.

Draw wire several times between fingers (or over edge of slate frame) to give it a curved form.

Twist the two ends of the wire together (using as little wire as possible for the twist).

Form the wire into as accurate a circle as possible, making it to lie flat on the desk. (A piece of white paper might be given to lay the wire on so that the shape may be better seen.)

Measure various diameters of the circle.

Press two opposite points of the circle together to meet and twist wire once there,—then form each part into a small circle, and make the figure so as to lie flat (Fig. 2).

Untwist the wire again (or use fresh piece), and model it into shape of leaf (according to copy on blackboard).

FIG. 1.

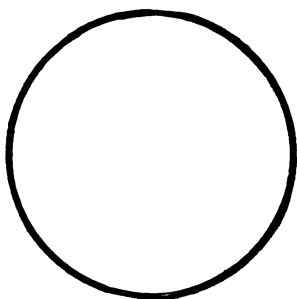


FIG. 2.

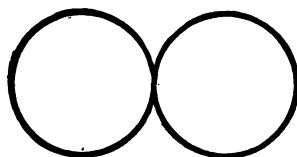
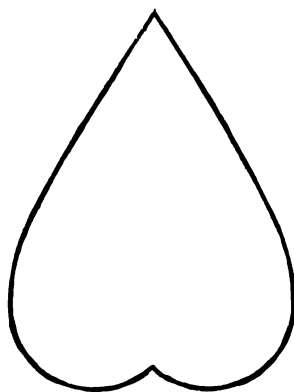


FIG. 3.



Exercise XXVII.**DRAWING AND WIRE MODELLING.**

MATERIALS.—*Wire about 13" long ; rule ; pencil ; squared paper.*

Draw in middle of squared paper a rectangle fourteen squares long by eight wide.

Mark points opposite middle point of long sides of rectangle and four squares distant.

Join these points to corners of rectangle to form hexagonal figure.

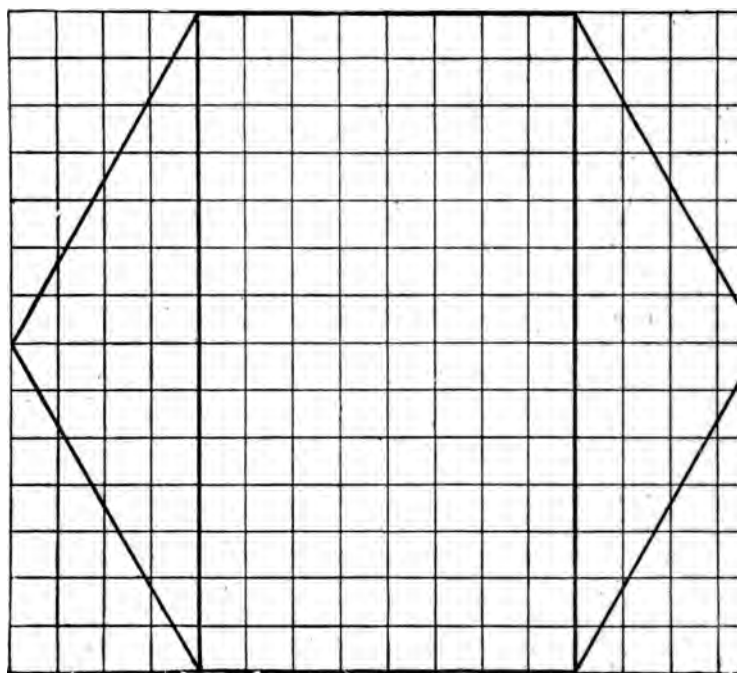
Measure sides of hexagon to prove that all are practically equal, and calculate the total length of wire required to form a similar figure.

Straighten out the wire, measure it, and bend aside the small piece not required for figure ; or, better still, bend a small extra piece at each end.

Estimate lengths of wire for each side of hexagon in succession, test, correct, and bend at approximately correct angle at those points.

Twist the ends of the wire together and make the angles equal to those of drawing.

Lay the figure formed in wire over the drawing to test its accuracy.



Exercise XXVIII.**DRAWING AND CUTTING LETTERS.**

MATERIALS.—*Squared paper ; ruler ; pencil ; scissors ; coloured gummed paper square ; damp sponge.*

(The teacher should first draw on the blackboard the plain capitals **I**, **T**, **N**.)

Draw on squared paper the capital letter **I**, seven squares long, one square wide.

Draw next a capital **T**, with the top bar five squares long and one wide ; and with a total height of seven squares.

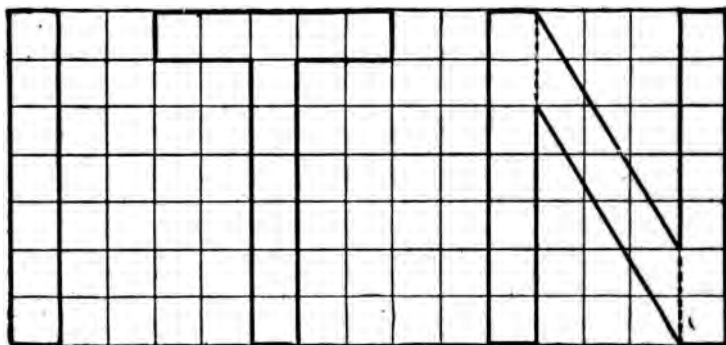
Draw capital **N** by first drawing two **I**'s equal in height to the other letters, parallel to each other, and with three clear squares between. Draw the diagonal lines from the end of one upright to a point two squares from the end of the other upright (see figure).

Cut out the outlined letters carefully with scissors.

Moisten each letter (in the above order) and fasten on gummed back of coloured square.

Cut out the letters as fastened on the coloured square. (If, as is probable, the **N** is fastened on so that when cut out it appears, as seen from the coloured side, as **M**, the plain side must be moistened and stuck down, and the letter again cut out.)

Lay the letters to form a word.



Exercise XXIX.**DESCRIBING CIRCLES WITH STRINGS.**

MATERIALS.—*Large white paper square ; pencil ; modelling board (clean) ; drawing pin ; two pieces of string, one 6", other 5" ; rule.*

Rule faint lines joining middle points of opposite edges of square. Place drawing pin through paper at intersection of lines and press firmly into the board.

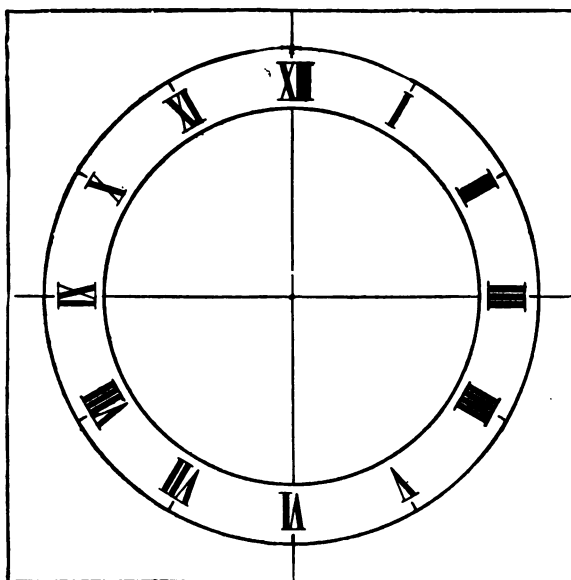
Make loops at ends of longer piece of string (or tie the two ends together), put one loop over drawing pin, and with point of pencil in other loop describe a circle (about $2\frac{1}{2}$ " diameter).

Make loops at the ends of the other piece of string, and describe a circle (about $1\frac{1}{2}$ " diameter).

Place drawing pin successively at quarter points (where the ruled lines cut the outer circle) and with the longer string, as used for drawing that circle, mark (as if about to describe an arc) points on the circumference of the circle.

From the twelve points marked rule short lines pointing towards centre of circles.

Print in figures, marking hours of clock.



Exercise XXX.**DESIGNING AND COLOURING (PLATE IV.).**

MATERIALS.—*Large white paper square; rule; pencil; crayons, with holders and stumps.*

Rule lines parallel to sides of square and distant one inch.
(The measurement and ruling must be accurately done to produce a satisfactory result.)

Divide the sides of the inner square (formed by the lines just drawn) into half-inches.

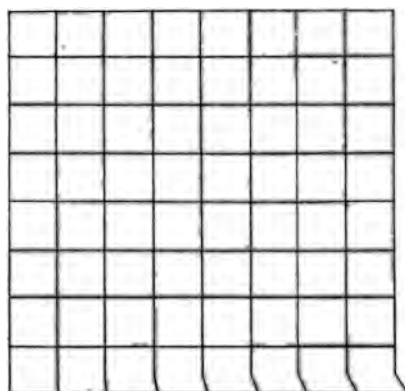
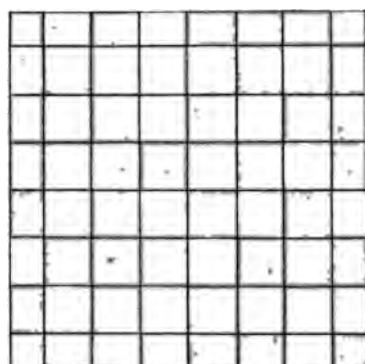
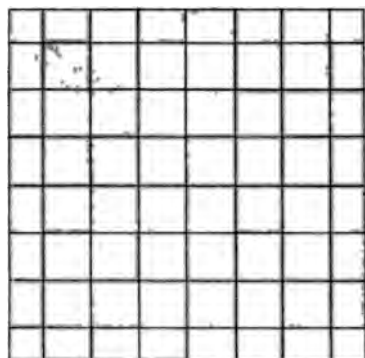
Rule lines joining opposite points so as to divide space into a number of small squares. (Let the children count the number, and note eight rows with eight in each row.)

Let the children colour the squares with crayons of two or three colours to make a definite pattern. (Several previously prepared patterns, as in Plate iv., might be shown to them first, and the principle of repetition pointed out. The children should then be left without any copy to produce their own patterns.)

Rule strongly the lines forming the squares.

THE END.

Plate IV.



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